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SCIENTIFIC AMERICAN

July 1930

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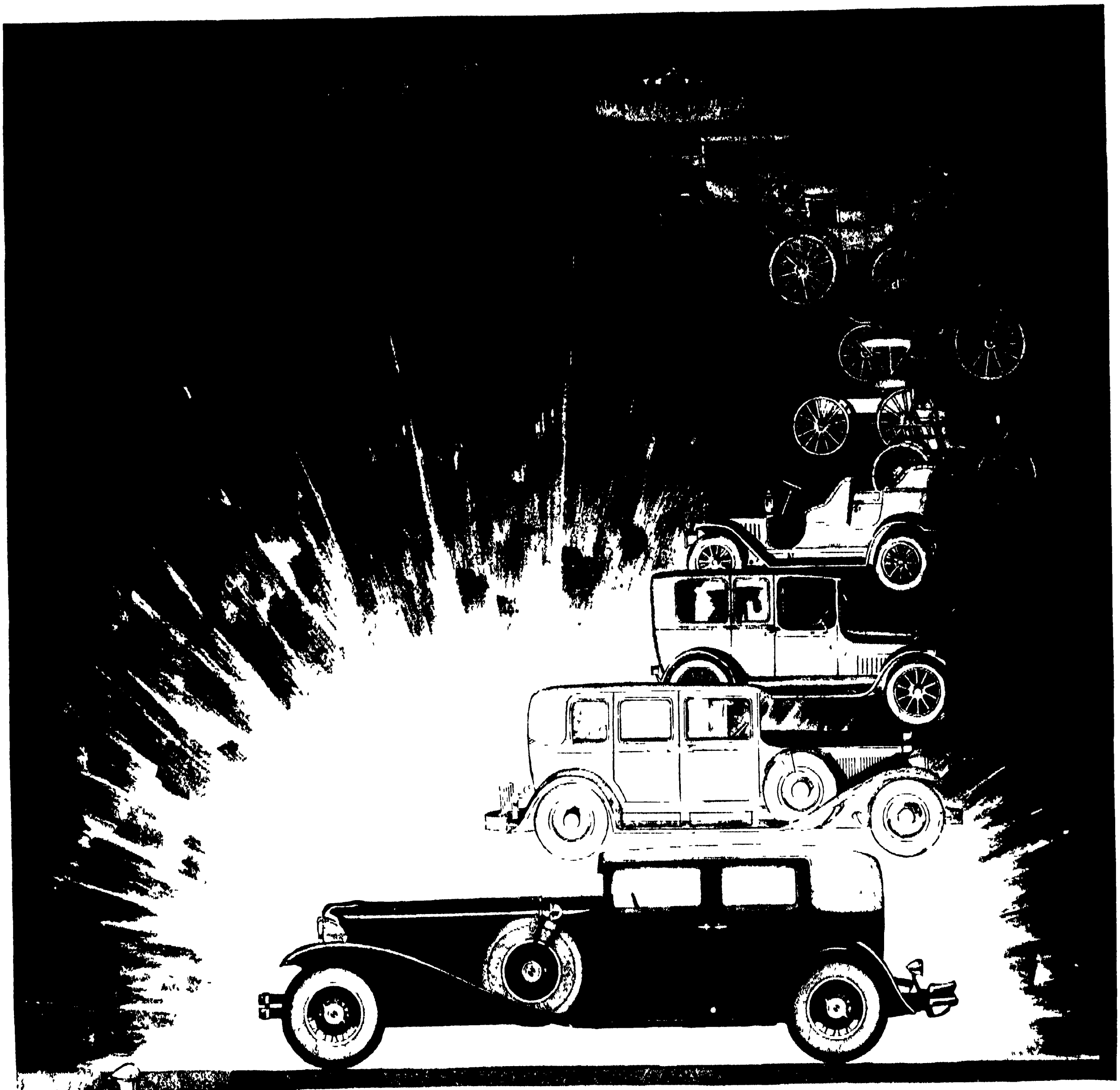

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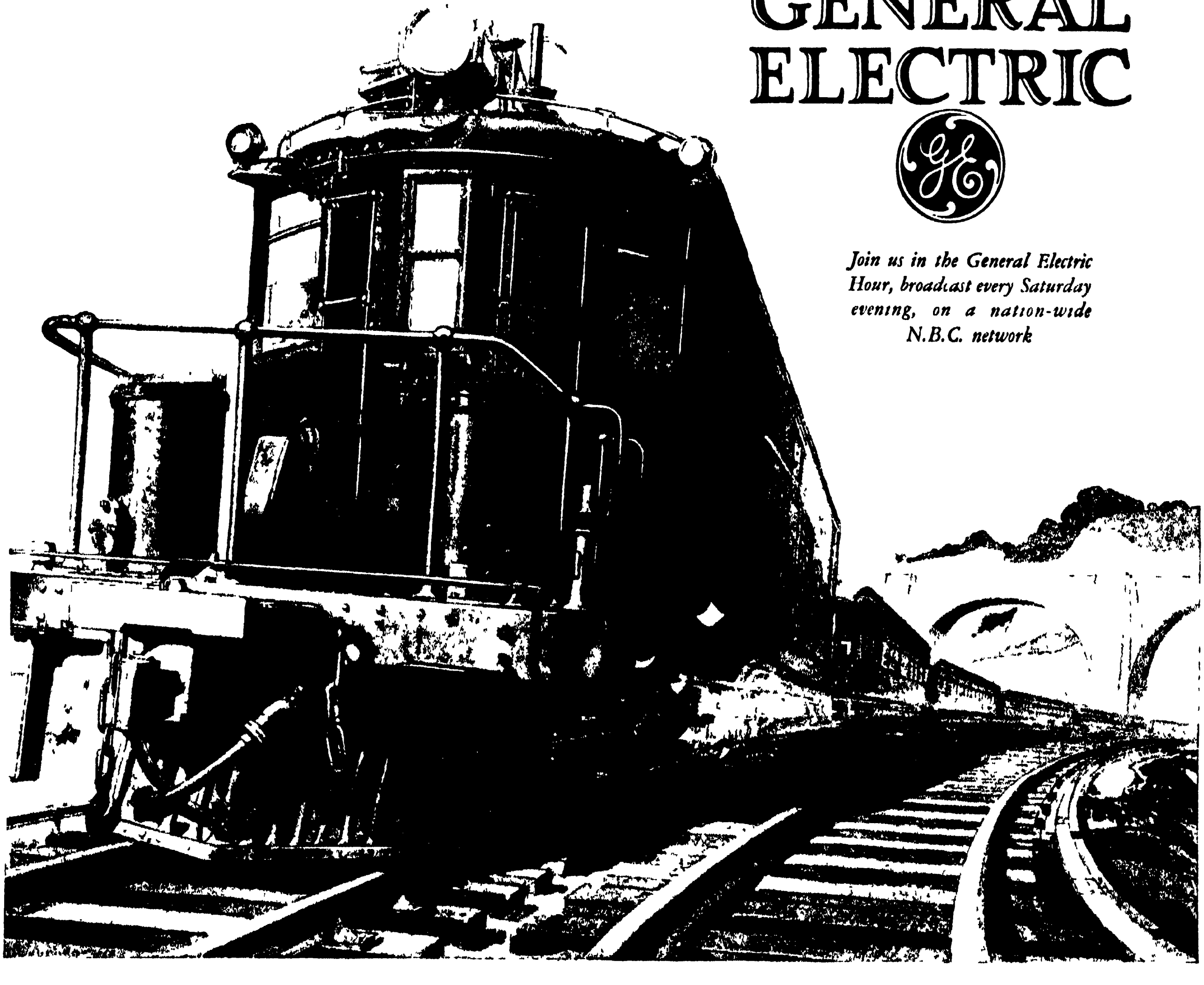

SCIENTIFIC AMERICAN

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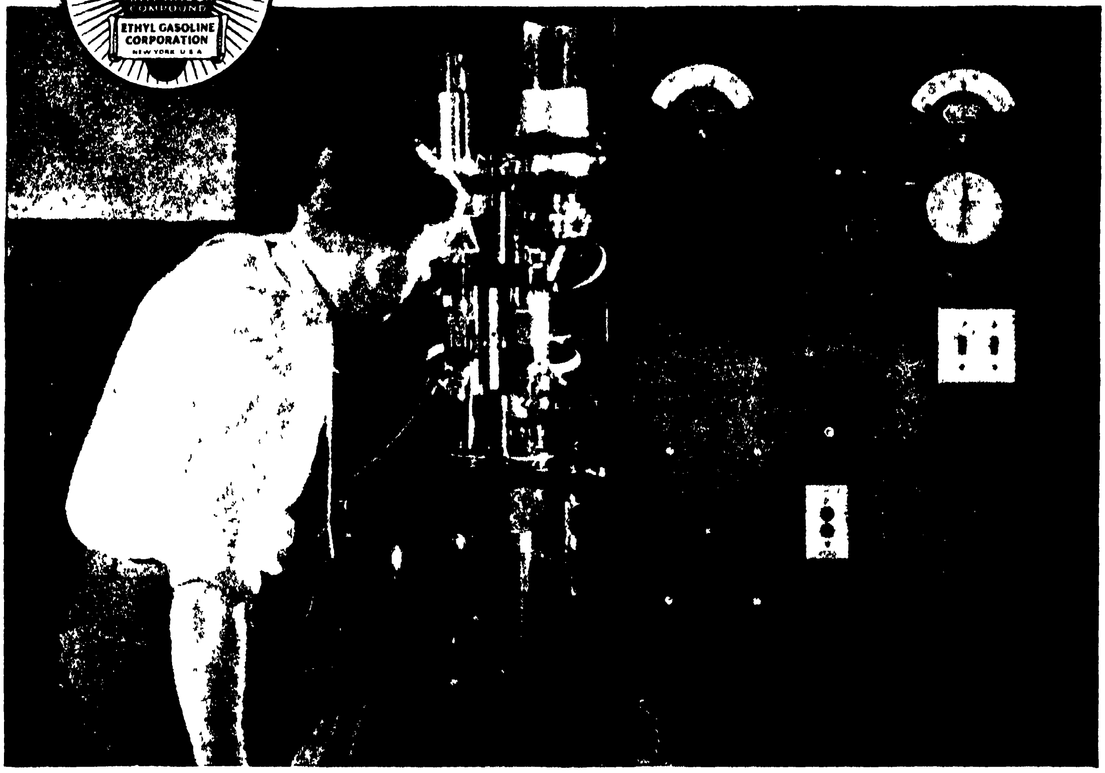
COVER

A new sport combining two modern devices the glider and the outboard motor—has been introduced in California and bids fair to become widely popular. Our artist, Howard V. Brown, has painted for our cover this month a vivid presentation of this sport. In the article on page 37 will be found a description of the "flying outboard motorboat," telling how it flies and something of the thrills that may be expected from it.

Why Ethyl is more than "*good gasoline*"



Scene in an Ethyl laboratory, where chemical and engine tests are made to insure the quality and anti-knock rating of Ethyl Gasoline.

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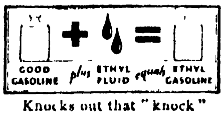

Knocks out that "knock"

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ETHYL GASOLINE

Looking Ahead *With the* Editor

Walking on Water

OF all the insect life we see on a summer's day in the country, the water skippers walking and dancing around on the surface of the water hold our interest and puzzle us. How do they do it? We study their actions and discover—but wait! The secret of how they walk on water, and certain other interesting things in connection with this accomplishment, as shown by careful experiment, will be told in a forthcoming article.

"Basic Patents" in Evolution

AN article ready for release draws an illuminating comparison between airships and the human body to illustrate evolution from "basic patents." But when the intricate engines of the human body were being tried out in nature's testing ground, no patent records were kept. This article, however, will review the evolution of human locomotor apparatus insofar as generations of men of science have been able to piece it together from "basic patents" by comparative methods.

Fingerprinting Diamonds

IT is not always easy to identify diamonds even by their flaws—and 96 percent of those mined are imperfect—but it has always been difficult positively to identify perfect stones—the other 4 percent. A new photomicrographic method of "fingerprinting" all gems, however, is as positive as the Bertillon system. This method will be fully described in these pages soon.

Burying a River

A RELATIVELY insignificant river that flows through residential sections of St. Louis presented a major problem. In times of flood, it rose to many times its normal proportions, flooded houses and factories, and caused great losses. How the problem was solved by burying the river in the world's largest sewer, and some of the engineering feats necessary on that job will be described in an article soon to come.

Forest Fires

THOUGHTLESSNESS, more than any other thing, caused the destructive forest fires that raged in the east last spring. It almost seems that people cannot be cured of their thoughtlessness but we must continue the effort. Your aid is enlisted. Read the coming article that deals with forest fires, the destruction they cause, the great expense of protection, and methods of prevention, and give your friends the startling facts.

Every Issue Fully Illustrated

¶ *The well-informed man or woman is the one who progresses. Why not let the* SCIENTIFIC AMERICAN *bring to you the latest news of the scientific world in general? The cost is nominal—only four dollars for an entire year's subscription.*

Among Our Contributors

M. R. Harrington

CURATOR of the Southwest Museum in Los Angeles, Mr. Harrington has made some important explorations and discoveries. He explored eastern Cuba and discovered that two distinct pre-Columbian peoples inhabited it in succession. He discovered the bluff-dweller culture of the Ozarks; explored Lovelock Cave in Nevada and discovered an ancient basketmaker culture; explored and interpreted Lost City; and explored Gypsum Cave. He has visited, lived, and worked with 33 tribes of North American Indians.

George P. Thomson

PROFESSOR THOMSON, of the Scottish University at Aberdeen, is the son of the noted Sir J. J. Thomson, discoverer of the electron. When he made the now famous experiment described in the article we publish, a great physicist told one of the editors that he "was not at all surprised," that he expected "the brilliant son to reach soon the same heights of attainment as his father."

Charles L. Lawrance

WHO, among the millions that thrilled at the news of Lindbergh's transatlantic flight, has not heard of Mr. Lawrance? He it was who designed the famous Wright Whirlwind engine, which powered the *Spirit of St. Louis* as well as other famous planes. Mr. Lawrance is Vice President of the Curtiss-Wright Corporation in charge of engineering. He has been a leader in the flying club movement and is the President of the successful Long Island Aviation Country Club.

George W. Crile

THE work of Dr. Crile, if fully listed and discussed, would fill volumes. He is one of the founders and the Director of the Cleveland Clinic. He has degrees from Vienna, Paris, London, and Dublin; honors, medals, and memberships in scientific and medical associations from many countries; and is a Chevalier of the Legion of Honor. The co-authors of his article, Maria Telkes and Amy F. Rowland, were trained in biophysics, the former in the University of Budapest, the latter at Mount Holyoke.

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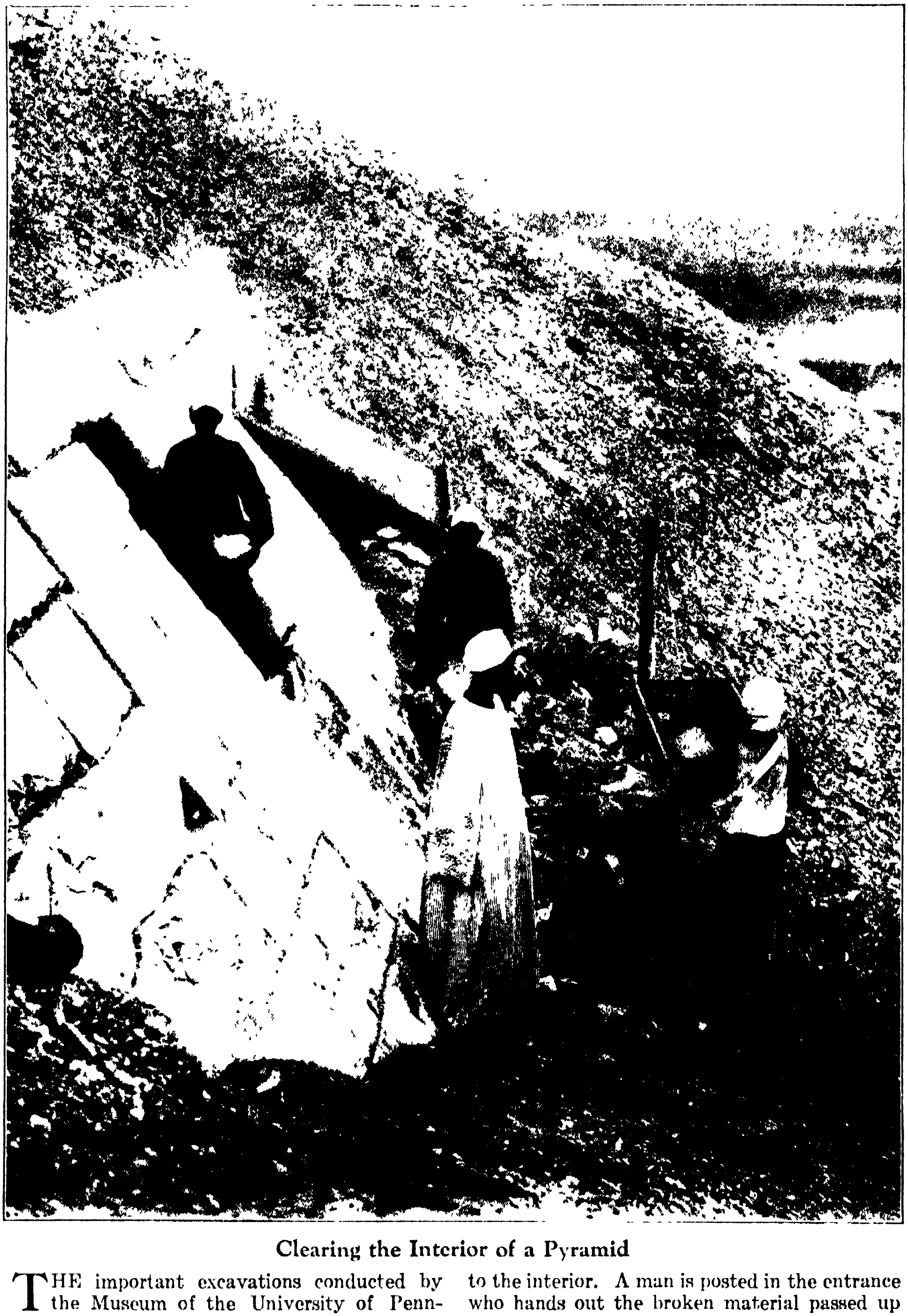
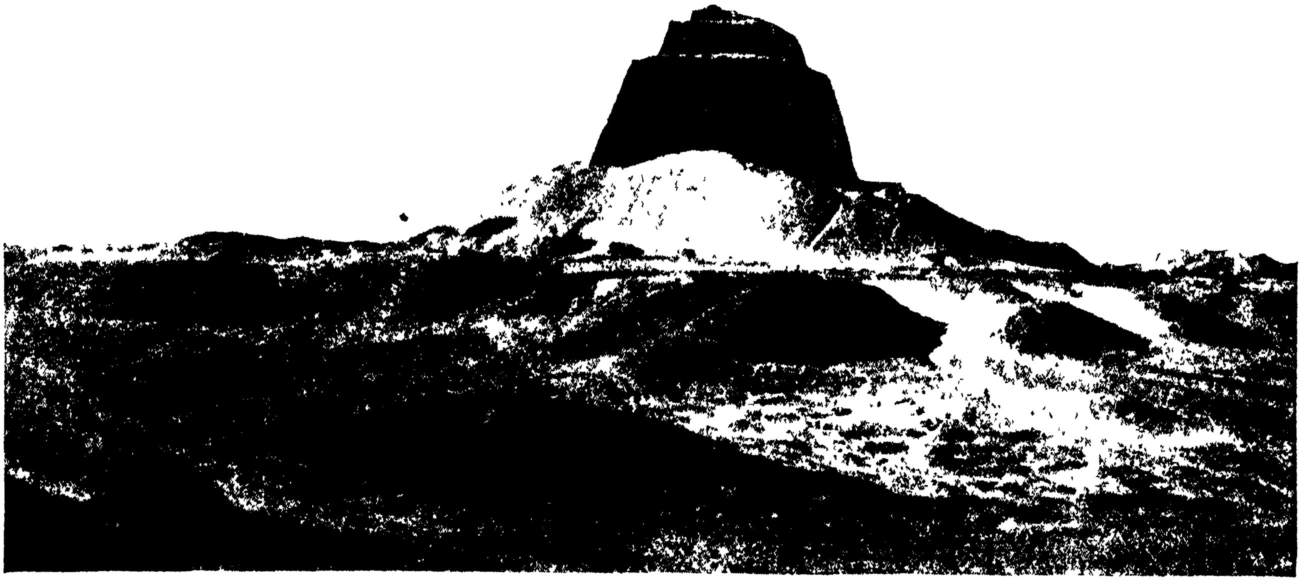
C. J. Davisson L. H. Germer

DOCTORS Davisson and Germer of the Bell Telephone Laboratories in New York performed experiments which furnished physics with concrete evidence that De Broglie and Schrodinger were right when they attributed a wave nature to the electron, hitherto regarded as a wholly material particle. The wave atom concept, explained on page 38, is now rapidly displacing the more familiar Bohr atom having analogy with sun and planets. This recent trend is likely to discomfit writers of popular science whose books have tended to create the unfortunate impression that the facts at last have been finally settled, instead of being constantly subject to revision in the light of new experimental evidence, as they actually are among physicists, and as they should be. Further discomfiture is in store for all who attempt to popularize the wave atom concept, for it has no cut-and-dried, familiar analogy like sun and planets and, strictly speaking, can be expressed only in the most agonizing of higher mathematics. Hence the planetary atom is likely to remain in style, popularly, some years after most physicists have discarded it. In the photograph Dr. Davisson holds in his hands the glass evacuated tube into which was sealed the same small apparatus shown on page 40. Dr. Davisson came to science via the University of Chicago and Princeton; Dr. Germer via Cornell and Columbia. They are typical examples of workers in pure science.



Clearing the Interior of a Pyramid

The important excavations conducted by the Museum of the University of Pennsylvania at Meydum pyramid in Egypt are fully described in the article starting on the opposite page. A casing of well-cut limestone blocks completed the pyramid. On the slant of the pyramid this masonry outcrops from the debris and an opening in the casing gives access to the interior. A man is posted in the entrance who hands out the broken material passed up through the long passage by a chain of 60 men. All the loose material, earth, et cetera, is carefully sifted to see if it contains valuable material. The sifter in our photograph shows great inventiveness, for Egypt. The "boy" has attached a sieve to a post, thus taking up weight.



All photographs courtesy Museum of the University of Pennsylvania

The Meydum pyramid of today, as reduced from the original form, showing the southern side. This illustrates the condition of the pyramid before last season's work began

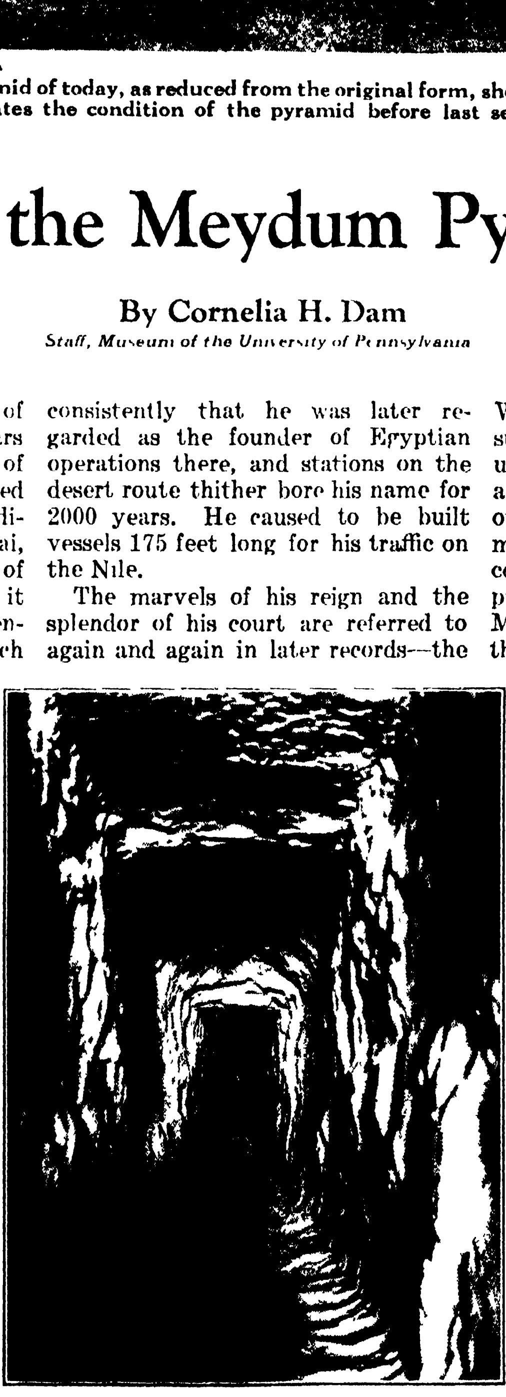
Exploring the Meydum Pyramid Site

By Cornelia H. Dam
Staff, Museum of the University of Pennsylvania

IN the age of Tutankhamen and of Rameses the Great, 1500 years before Christ, the Pharaohs of Egypt, whose empire extended from the heart of Nubia to the Mediterranean and included Libya, Sinai, Syria, and Palestine, used to boast of their exploits that "nothing like it had been done since the time of Seneferu." This venerable name, which echoes through Egyptian records for two thousand years, designates the first really great historic king of Egypt, father of that Cheops (Khufu) who built the great pyramid of Gizeh, near Cairo.

WITH Seneferu, who died about 2900 B.C., we are at last on firm ground in Egyptian history. He laid the foundations for the Fourth Dynasty, that remote, magnificent period of which the art was never again equaled, and of which the great pyramids of Cheops, Chephren, and Mycerinus are the immortal monuments. From later records, notably the Palermo Stone, we know something of his exploits: he united Egypt under his rule from Nubia to the Mediterranean, and invaded Libya, returning with 7000 prisoners; he sent a fleet of 40 vessels to the northern coast of Syria for cedar logs, and expeditions across the desert into the Sinai mountains for copper, so consistently that he was later regarded as the founder of Egyptian operations there, and stations on the desert route thither bore his name for 2000 years. He caused to be built vessels 175 feet long for his traffic on the Nile.

The marvels of his reign and the splendor of his court are referred to again and again in later records—the Westcar papyrus relates how the king, suffering from ennui, was taken to row upon a lake, with a gay party of youths and maidens, and all went well until one of the girls dropped a favorite malachite pendant overboard. But a court magician saved the day by piling up the waters of the lake, as Moses did the Red Sea, and recovered the jewel.

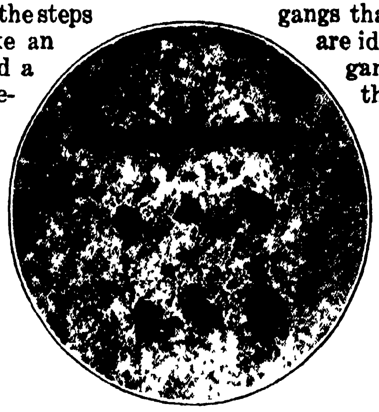


A long passage sloping downward leads to the tomb of a Pharaoh in the pyramid

At Meydum, about 50 miles south of Cairo, where the western desert edge touches the fertile floor of the Nile valley, Seneferu built the earliest known true pyramid, for the two similar earlier constructions at Sakkara and at Zawiet el Aryan seem never to have had added the outer casing which would have turned their stepped stages into a true pyramid form. And at Meydum, time and weather, and above all the depredations of man, have destroyed most of the casing and exposed the stages and the rubble core of its construction, so that today the pyramid presents a stepped appearance, not unlike the staged towers of Babylonia, and has therefore often been called a "false pyramid." Excavations, however, have revealed the original casing blocks on the lower stages, and the methods of construction, which are of considerable interest for the history of the development of architecture.

The pyramid seems to have been

built cumulatively, quite possibly over an original mastabah tomb, as a staged building of seven stories, to which a later coating was added, increasing the stories to eight; finally the steps were filled in to make an even inward slope, and a casing of well-cut limestone blocks, quarried far away across the Nile, and floated over during the inundation, completed it. The original height of the pyramid has been estimated as about 300 feet; the existing stages rise only 214, but it is still an imposing pile, visible from many miles around.

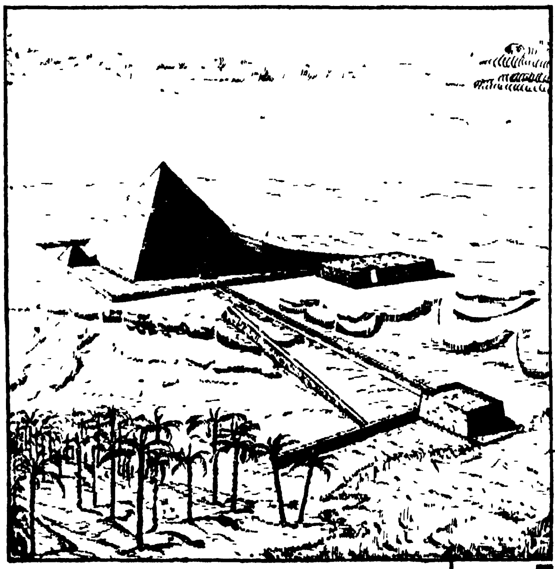


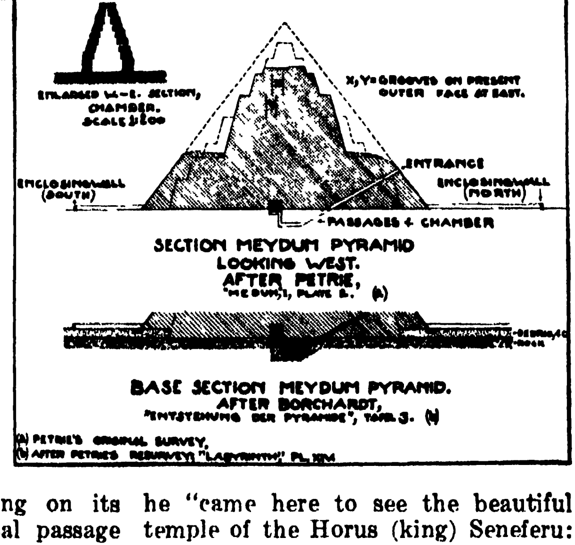
"Six cubits," a quarrymen's mark in black paint on a stone of the pyramid

The cumulative construction evident in this earliest true pyramid is particularly interesting for the light it throws on the probable development of that architectural form from a mastabah, because the next pyramid in date, that of Cheops at Gizeh, was obviously planned in its finished form from the beginning. We might say that Seneferu *invented* the pyramid!

Three great Egyptologists, Mariette, Maspero, and Petrie, had each done work at Meydum before the Museum of the University of Pennsylvania undertook excavations there last November. But the site had never been thoroughly explored, and it was with reasonable, and soon justified, hopes of important finds that Mr. Alan Rowe took the field as director of the expedition.

The first work undertaken was on the pyramid itself, removing the centuries' accumulation of debris and rubbish from its base, and clearing the passages and chambers in the interior. It was a long and laborious task, involving the removal of hundreds of tons of debris, and the labor of a large party of workmen for the greater part of the season.




ENLARGED W.-E. SECTION, CHAMBER. SCALE 1/200
X, Y = GROOVES ON PRESENT OUTER FACE AT EAST.
ENTRANCE
ENCLOSING-WALL (SOUTH)
ENCLOSING-WALL (NORTH)
PASSAGES & CHAMBER
SECTION MEYDUM PYRAMID LOOKING WEST. AFTER PETRIE, "MEDUM," PLATE II. (a)
DEBRIS, &c
ROCK
BASE SECTION MEYDUM PYRAMID. AFTER BORCHARDT, "ENTSTEHUNG DER PYRAMIDE", TAF. 3. (b)
(a) PETRIE'S ORIGINAL SURVEY.
(b) AFTER PETRIE'S RESURVEY, "LABYRINTH," PL. XIV

***Above:* A reconstruction of the pyramid site, showing pyramids and adjacent structures. *At the right:* Sections of the pyramid**

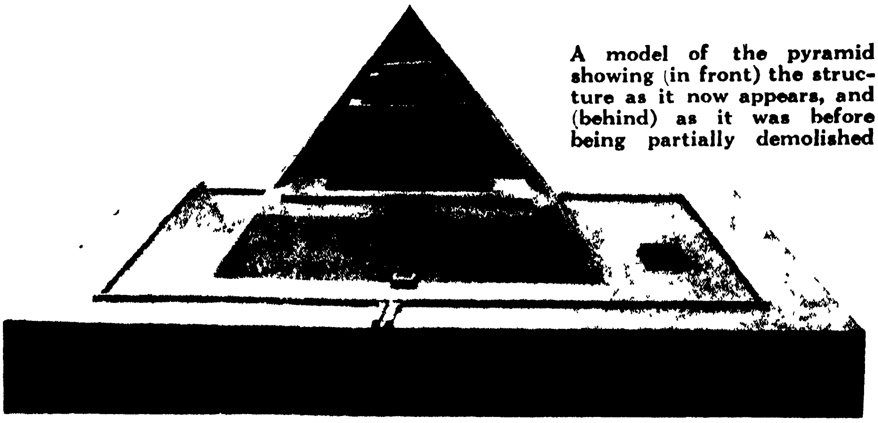
On fragments of stone found in the debris around the base were painted inscriptions giving the dates of the 16th or of the 17th year of the king's reign, apparently the year in which the casing was put on, and the pyramid completed. These marks were put on the blocks in the quarry, before they were transported across the valley and presumably for the purpose of making a count of the number cut each day by the different gangs of workmen employed on the operation. The word *aperu*, which means "gang," also appeared. The names of a number of the gangs that worked at Meydum are identified: the "pyramid gang," the "north-gang," the "enduring-gang," the "vigorous-gang," and the "scepter-gang." Lines in red paint, the original levelling lines of the builders, and their measurements in cubits also appear on the stones still in situ on the pyramid.

The task of clearing away the debris outside is not yet completed, but the interior was finished in time for the visit of the king and queen of the Belgians on March 30. The entrance to the pyramid, once carefully concealed, is some 60 feet from the ground on the north side, thence a long narrow passage, less than six feet high, descends for 185 feet to an antechamber, about twice as wide as the passage, on its left, and another immediately following on its right. Thence a horizontal passage leads to the shaft which opens into the sepulchral chamber some 20 feet overhead. It is a tiny room, about 20 feet long and high, but only nine feet wide, with stone walls and floor, and a steeply corbelled ceiling.

To clear the interior a long chain of men, increasing as they worked inward to the number of 90, was formed to pass in empty baskets and pass them out full, for in the narrow passage only one man at a time could work with pick and hoe. "It is a long and tedious job," wrote Mr. Rowe, in his monthly report to the Museum, "as the farther we penetrate the worse the air becomes. In fact when we had reached the bottom of the sloping passage leading from the outer entrance, just at the point where the passage runs into an antechamber, we were able to work for only one hour each day. At the end of this time our candles went out, warning us that it was unsafe to remain inside any longer." Nothing of very great importance was found inside the pyramid, as it had been opened and robbed in antiquity—how soon after it had been sealed up we cannot say, certainly it was open in the Twentieth Dynasty (c. 1200 B.C.), for the names of two scribes who visited it then are still visible on the ceiling of the passage. "Fools' names" are often valuable evidence in archeology!

AGAINST the east face of the pyramid is a small temple, consisting of a vestibule and a little rectangular room, behind which, in a courtyard, stand two uninscribed stelae with an offering table between them. On the walls are pictures and scribblings put there by visitors to the sacred precincts 3500 years ago. One scribe of the time of Thothmes I. (c. 1500 B.C.), wrote on the wall that he "came here to see the beautiful temple of the Horus (king) Seneferu: he found it like heaven within when the sun-god is rising in it: and he exclaimed 'the heaven rains with fresh frankincense and drops incense upon the roof of the temple of the Horus Seneferu.' "

From the valley edge (the inundation level), where by analogy with other pyramid sites there should be a small entrance temple, although none has yet been found, there runs a long brick-faced causeway, by which pilgrims in ancient days might approach the sacred pyramid area, which was surrounded by a wall, and enter it by a gate at the end of the causeway, directly opposite the entrance to the temple. To the south of this causeway are the remains of another, which was evidently used as a road to haul material during the construction of the pyramid, then partly destroyed and covered over.

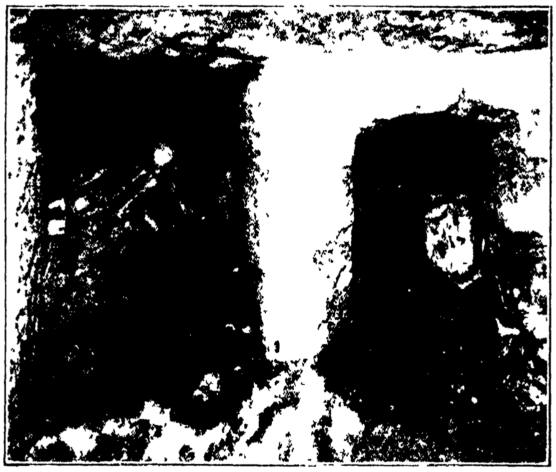


A model of the pyramid showing (in front) the structure as it now appears, and (behind) as it was before being partially demolished

WITHIN the pyramid precinct wall are the remains of a miniature pyramid, perhaps a queen's, on the south, and of a large, presumably a royal, mastabah-tomb on the north.

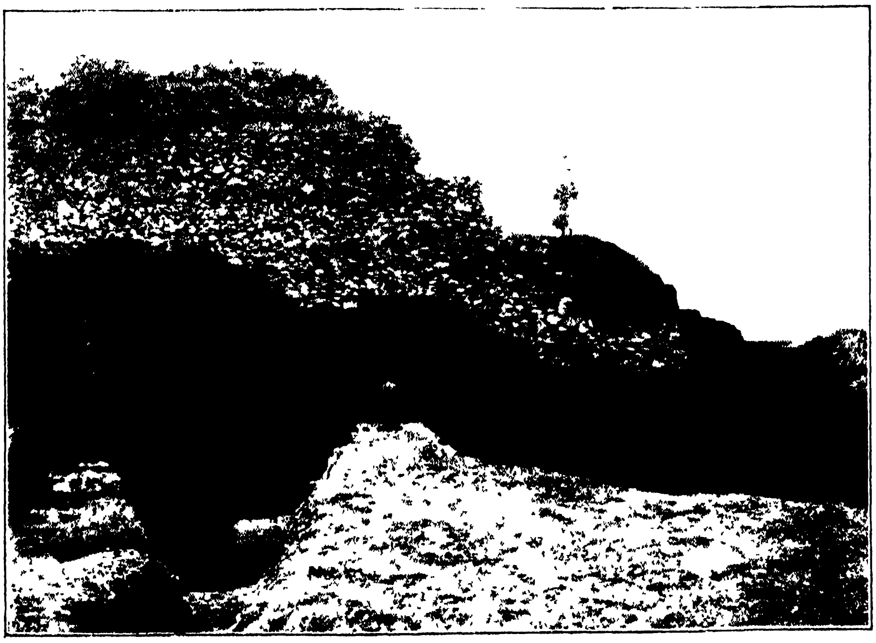
It is not known where Seneferu was buried. If it was at Meydum, his body was subsequently removed, either by tomb robbers, in which case it was probably destroyed, or by his pious successors who wished to avoid just such a catastrophe, in which case there is a fair chance of yet discovering it, either at Meydum, or at one of the other great Fourth Dynasty cemeteries of lower Egypt. The transferred burial of one of his Queens, Hetep-heres, mother of Cheops, was found recently by the Harvard-Boston Expedition near her son's pyramid at Gizeh, near which is also the tomb of Seneferu's eldest daughter, Nefert-kau, sister-wife of Cheops. His eldest son, Ka-Nefer, on the other hand, was buried at Dahshur, (where Seneferu had built a second pyramid, not as a tomb, but as a cenotaph) and two other sons and their wives were buried at Meydum. From the tomb of one of these royal couples, Ra-hotep and Nefert, came their portrait statues (now in the Cairo Museum) which many people consider the finest known Egyptian statues, and from the other, that of Nefer-Maat and Stet, the equally famous painting of Geese (also in Cairo) and a beautifully painted fragment in the Museum of the University of Pennsylvania.

All around the pyramid of Seneferu stretches a vast cemetery, including examples of various types of burials used in Egypt from the Fourth Dynasty down through Ptolemaic times (3000-300 B.C.), a strong indication of the enduring renown of the sacred character of the site.



In rock-cut chambers piled-up coffins gave the appearance of a forgotten lumber room

Simultaneously with the work on the pyramid Mr. Rowe started clearing a large mastabah (Number 17), which is some 350 feet long and half as broad, and is situated just to the northeast of the pyramid. The name of the original owner has not yet been discovered, but it must have belonged to a member of the royal family or at least to a very important person. Its construction proved to be analagous to that of the pyramid; that is, it was built originally in three steps, which were later filled in to give the even inward slope of a mastabah. Two brick-faced ramps led from the valley up to the eastern face of the tomb. The northern one once led to the top of the mastabah, and the southern one to a little chapel, or niche, of which only the floor now remains, but traces of the walls, as thick as the chapel was wide, enabled Mr. Rowe to reconstruct the plan of an imposing building of pure white limestone. The walls were once highly polished, and the hard stones used in the process were found in the debris nearby.



North end of east side of mastabah tomb No. 17 showing the stepped stages in the stone core which were later filled in to support a brick casing

PROFESSOR PETRIE found a tomb chamber behind the niche when he worked at Meydum, so the discovery this year of a second niche at the northern end of the same side, led Mr. Rowe to hunt for another chamber and possible burial in it, at that end of the tomb. When sending his last report, he had not yet found it, but the search goes on.

In clearing the heavy retaining walls of the mastabah, he found that they were honeycombed with intrusive (i. e.—later) burials, most of them dating from the New Empire (1500 B.C.) and later. They represent chiefly the burials of the common people, and fall into three main catagories:

(1) Unwrapped skeletons, and mummies buried simply in linen wrappings,

often fringed, occasionally with green borders;

(2) Mummies to which an additional covering of reed or palm-frond mats were added; and

(3) Mummies in coffins. Rectangular coffins were usually undecorated except for a coat of whitewash, and confined to the burials of children, adults being buried in rather crude anthropoid coffins of the type of "mummy cases" to be seen in most museum collections of Egyptian antiquities.

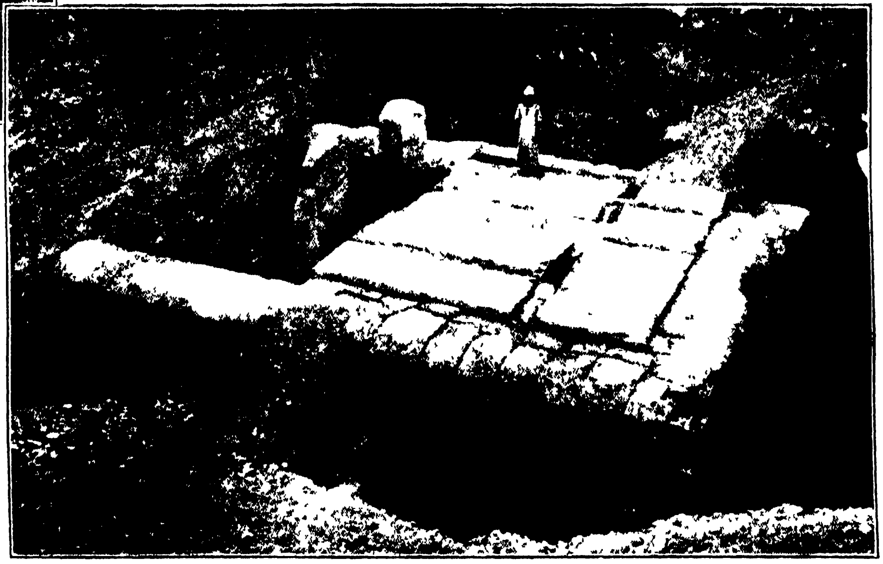
In the mastabah, or noble's tomb No. 17, the north (outer) casing wall is 56 feet high. Note the excellent brickwork

Pottery dishes and bowls buried with the mummies contained grapes, dates, palm-fruit, pomegranates, or other food, and of course there was an abundance of the essential equipment for a pleasant after-life which is usually found in Egyptian tombs: boxes of eye-paint, trinket-boxes of wood, amulets, scarabs, beads, earrings, pins and bracelets, combs of wood and haircurlers of bronze, the scribe's palettes and the craftsman's tools.

THE burial of so many persons in the actual walls of the mastabah, (not a very convenient place), indicates that the tomb was highly venerated 2000 years and more after it was built, and Mr. Rowe suggests that as the only person we know of who was so long venerated was a magician, Zedi by name, who lived in the time of Cheops, and who at the age of 110 ate 500 loaves of bread and a haunch of beef, and drank a hundred jugs of beer a day, the great mastabah might have belonged, either actually or traditionally, to this picturesque and very remarkable person.

Just to the east of the great mastabah Mr. Rowe found a miniature replica of it; it had been plundered in antiquity, and only one of the three pits beneath it contained the original Fourth Dynasty burials. Of the many types of burials already cleared in the neighborhood of the pyramid, the majority belong to the New Empire, a thousand years later than the pyramid and mastabah-tombs. There are however, a number of contemporary, that is Fourth Dynasty, tombs, most of them simply large pits with two or three recesses in the sides, in which lay skeletons, although two of the number so far excavated had large masonry chambers, illustrative of the increasing use of stone in place of brick for private as well as royal tombs in this period.

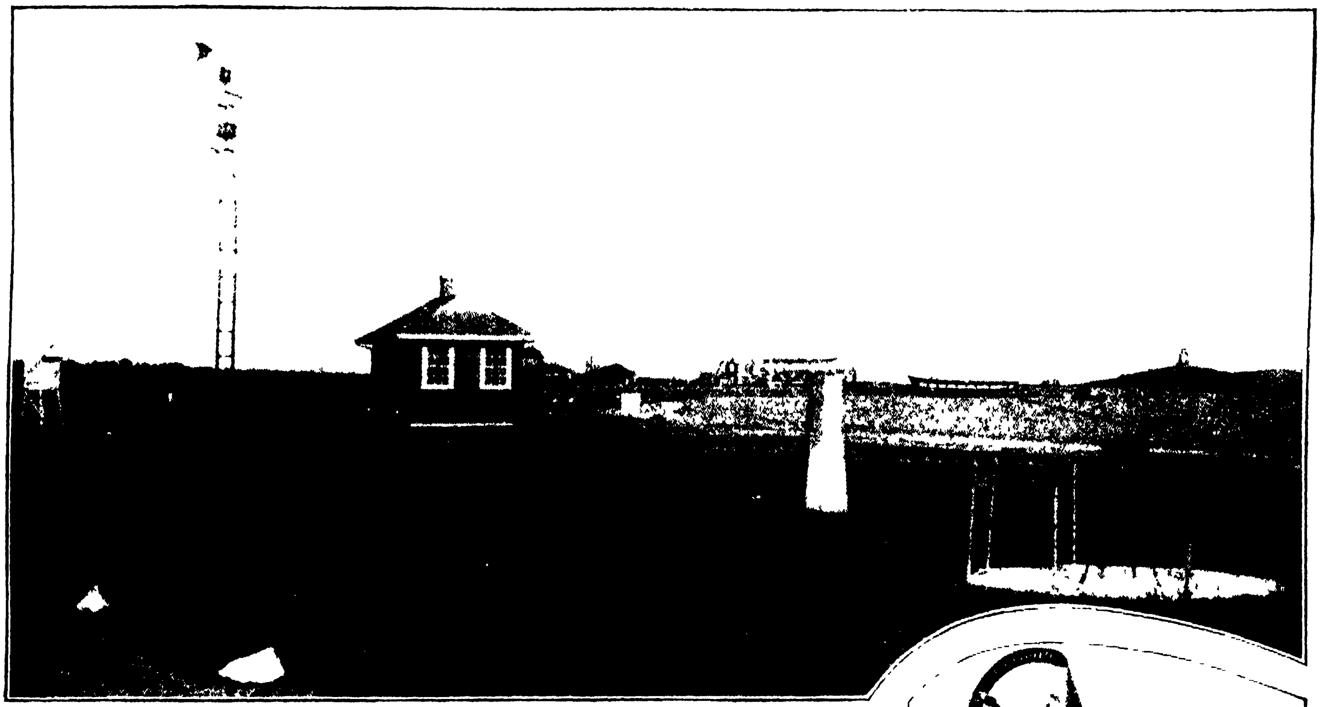
The most exciting and spectacular discovery of the season came in January, when, exploring a depression in the sand to the southwest of the pyramid, Mr. Rowe came upon a group of twelve rock-cut chambers, many of them stacked ceiling-high with coffins, "for all the world," he wrote, "like a forgotten lumber room." There were 101 mummies, besides 29 simple burials, the largest number of Ptolemaic mummies ever found together in Egypt. Of course the tomb had to be guarded day and night until it was cleared, and the first night the Arab workmen were afraid to sleep there until two of the staff joined them, and at that passed most of the night exchanging ghost stories. "They certainly had the right setting in which to relate their experiences," Mr. Rowe added, in his report on the latest discoveries.



Against the face of the pyramid is a temple consisting of a vestibule and a room; behind stand two *stelae* or pillars, with an offering table between. The location of this temple is shown in the model illustrated on page 11

The majority of the coffins belong to the Twentieth Dynasty (c. 1200 B.C.) or later, and one of these contained the finest mummy yet discovered at Meydum. Its outer coffin was badly damaged by rock falls within the room, but the inner one, beautifully decorated, was well preserved, as was also the mummy itself, covered with a network of glazed pottery beads; on its head was a gilded mask, and on its breast a golden winged scarab. Two of the coffins are Twelfth Dynasty (c. 2000 B.C.), delicately painted with texts from the Heliopolitan Recension of the Book of the Dead, prayers for offerings of cakes, ale, beef, geese, bread-rolls, clothes, incense, and oil on festival days. "O lady of the house, Sat-Her-em-hat, triumphant, revered before the gods who are in the other world, they transfigure thee. Take to thee thy head, and collect to thee thy bones," says one verse.

AND truly, the bones of those long-buried Egyptians who strove so hard to preserve them against time, and so cunningly to hide them in pits, pyramids, and shafts, from the impious tomb robbers of their own day, are safer now than ever, in the reverent hands of science. The careful excavator is bound to earnest respect for the remains of these long-forgotten people, lest he lose through heedlessness some minute bit of evidence of great scientific value, and he spares no pains to develop the all-seeing eye and the sympathetic mind that may enable him to reconstruct for us, vividly, accurately, and at last completely, the life and thought of this great civilization that vanished from the earth so many centuries ago.



Researches In Fog

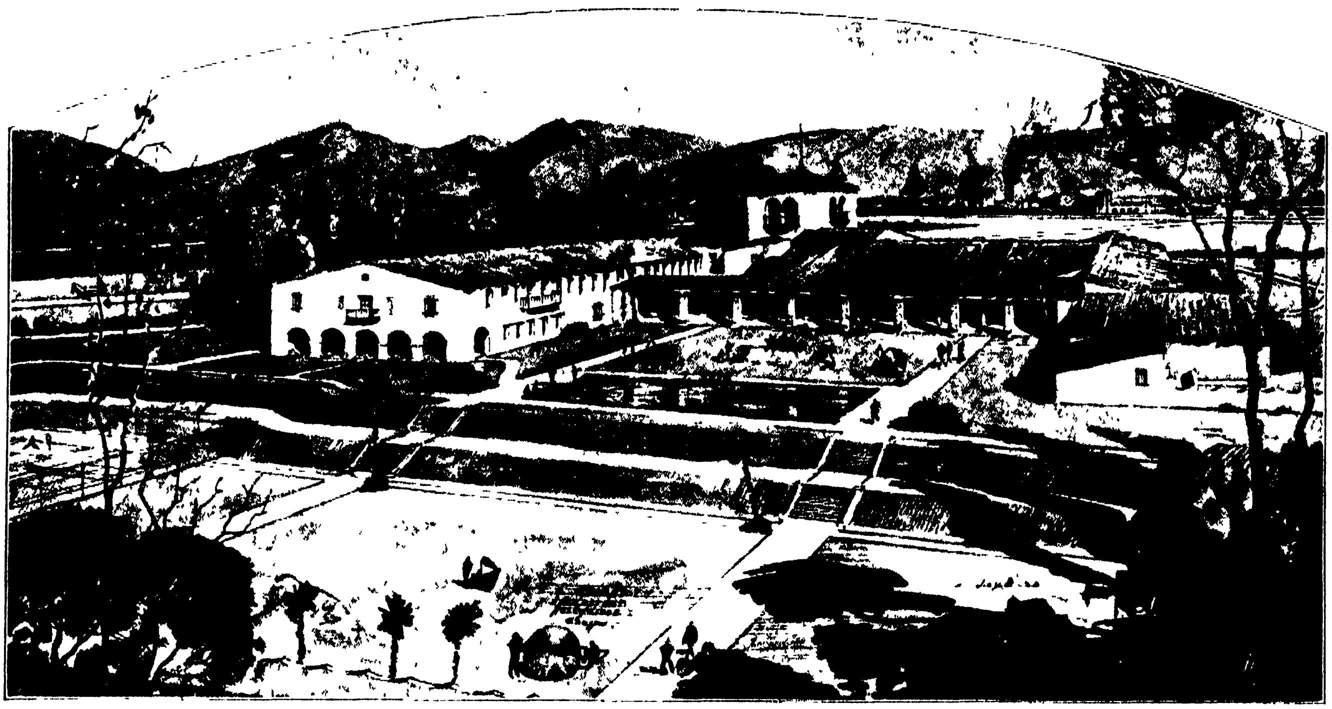
FOG, still the enemy of the navigator on the sea and in the air, is being put "under the microscope" at Massachusetts Institute of Technology's new meteorological laboratory at Round Hill, Massachusetts. The observatory's aim is to gain new knowledge of the atmospheric conditions that produce the score or more forms of fog that scientists have classified, and to develop methods of forecasting and possible future prevention and dissipation of fog.

The observatory will seek to develop, first of all, an accurate method of measuring absolute humidity. Distribution of temperature in fogs and clouds of various heights will be studied, and determinations of the thickness of fog banks will be made. Throughout the studies, the various physical characteristics of fogs will be correlated with weather conditions.

Among the studies now being made is one that concerns the navigation and landing of aircraft in fog, as well as methods of communication between pilots and the ground, and between aircraft in flight.

These studies include: the use of special navigation instruments, research in the penetration of lights of various colors through fog, methods of accurately determining altitude above the nearest ground instead of sea level, and visible and invisible electrical airport landing beacons.

At the top of the page is a general view of the new meteorological observatory on the estate of Colonel E. H. R. Green. In the second illustration down, a pointer is sighted at a point on a nearby cloud to determine cloud ceiling. *Directly above:* the electrically operated rain gage which registers precipitation in hundredths of inches. *At left:* recording room containing wind direction and velocity meters and a barograph



An architect's drawing of the clubhouse and grounds at Grand Central Air Terminal, Los Angeles, which the Flying Club of California has leased from the owners of the airport. Further details are given in the text

Flying Clubs for Private Fliers

By Charles L. Lawrance*

THERE are three hundred and four flying clubs in the United States today owning plane equipment. This figure is derived from reports of the Department of Commerce covering the licensing of aircraft and includes all cases where a group of individuals have jointly bought a licensed airplane. Undoubtedly many of the clubs included in the figure are of extremely loose organization owning but a single plane and renting hangar space from the nearest airport. Yet the number itself is surprising. It is estimated that 50 percent of the clubs have sprung up during the past 18 months.

In other words, American men and women are taking to the air through the most practical means at hand – the flying club. By organizing into groups, people can afford to buy and to maintain an airplane the cost of which may be beyond the means of any one of the group. The small flying club is one of the most important manifestations of democracy in the airplane field today. It means that flying is not only for the rich but is possible for men of moderate means who are willing to work together so that they may fly.

In no place is this co-operative movement toward flying more clearly marked than in American colleges. While only at Harvard University do students own their own ship, yet the tendency to combine into organized units to promote flying has touched nearly all of the great universities. On May 10 in connection with the Air Show in New York City the first college aeronautical conference was held. Delegates from the flying clubs of 10 colleges were flown to New York in planes of the Curtiss-Wright Flying Service which picked up representatives from as far west as the University of Kansas.

OTHER universities represented included the University of Illinois, the University of Michigan, Ohio State University, and New York University. In every case it was reported that members of the clubs were putting in flying time with planes rented from the nearest airport. In some cases faculty opposition was reported, but as a rule professors themselves were said to be interested in the movement. The membership of every club included a number of licensed pilots, in some cases of the higher grades.

Thus the flying club, even where no equipment is owned, is a powerful factor in increasing the number of people who fly and know how to fly. At the same time larger clubs have made flying a far more comfortable and convenient thing than it ever has been before. This is especially true in the case of such a club as the Aviation Country Club of Long Island opened over a year ago. This club, modeled more on the flying clubs of England and Canada, owns its own clubhouse and field as well as four planes. It includes an associate membership of 180. Fifty planes are owned privately.

The formation of such a club represents a large outlay of capital and its membership is of necessity limited to the more wealthy type of individual. On the other hand the small, loosely organized club which rents hangar space from the nearest airport is under the handicap of having no clubhouse or headquarters. A compromise between these two types of club is now being worked out by the Flying Club of California which in July will move into the clubhouse being built for it at Grand Central Air Terminal outside of Los Angeles.

The expense of building the 200,000-dollar Spanish-style clubhouse is being borne entirely by the Curtiss-Wright Airports Corporation, the owners of Grand Central Air Terminal. The corporation is renting the clubhouse to the Flying Club of California for a period of 20 years. Because the rental is relatively low, the dues of the Flying Club of California are only six dollars a month. Its members, however, will enjoy one of the most luxurious clubhouses in the country, equipped with dining and sitting room, squash courts, and swimming pool, with tennis courts outside and two golf courses immediately adjoining.

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*See "Among Our Contributors" page 5.

It is evident that membership in such a club is at once attractive to a man who, on the one hand, could not afford to join a club which owns its own house and field, and who, on the other hand, is unwilling to put up with the inconveniences inherent in a club which has no permanent headquarters. It is altogether probable that the next few years will see clubs similar to the Flying Club of California established at the great eastern and middle-western airports.

In the vicinity of New York, for example, there are a number of fields at which flying clubs could establish themselves in co-operation with the owners. Land has been set aside at the Curtiss-Wright Airport at Valley Stream for the building of a clubhouse for lease to a private flying club. Residents of the Oranges and Morristown, New Jersey, on the other hand, may some day organize into a club which will make use of the facilities of Essex Airport at Caldwell. The fact that many New Yorkers live in the country during the summer makes such ports particularly well suited to flying clubs.

Members of a flying club which has its clubhouse at a large landing field naturally enjoy all of the facilities of the port. Hangar space, machine shops, and repair facilities are all at hand. Flying instruction, always an important consideration in forming a club, is available at most large flying fields.

It is interesting now, when the United States has plenty of flying-club news and activity of its own, to look back only a year when most of our knowledge of such clubs came from abroad. The retrospect shows that, although the flying club in America is a new thing, it has already exhibited marked differences from the clubs of Europe. In no case is the difference more striking than in the matter of subsidy from the government.

English clubs, which were the first in the field and developed soon after the war, were almost all subsidized. The English government gave 10,000 dollars to a club on its formation, for buying two airplanes and thereafter 5000 dollars a year for purposes of upkeep. Under this stimulus English clubs spread rapidly and gradually came to own their own flying fields instead of using the army fields. Today English clubs include many thousands of members with much flying time to their credit.

NO subsidy has ever been given to American clubs. Although the stimulus might have developed the movement here more swiftly, in the long run the absence of subsidizing should prove beneficial. American clubs gain an enormous amount of vitality by standing on their own feet financially. In this connection it should be noted that just as American clubs have proceeded without government aid, so, too, members of such a club as the Aviation Country Club of Long Island have tended to buy their own planes rather than to depend on the planes of the club. The fact that 50 planes are privately owned by members of this club is a distinct departure from European tradition

A glance at the roster of the planes owned by members of the Aviation Country Club of Long Island discloses a third difference. The roster includes not only small planes such as the Moth but also cabin planes such as the Travel Air, the Robin, and the Keystone Loening amphibion. In other words, pleasure flying in America does not necessarily mean "light" flying as it does in England where distances are so much shorter. While the Englishman can use a small plane for getting to his week-end destination, New Yorkers who wish to fly to Florida or the Thousand Islands will of necessity turn to the heavier cabin type of plane.

The fact that American clubs have been developing rapidly and along their own lines should not obscure the fact that flying clubs have progressed in other countries. In Canada, for example, during 1929, members of its 23 large flying clubs flew over 1,232,000 miles in 15,100 hours of flying time. Total membership in Canadian clubs is 5092 and at the end of 1929 there were 396 solo flyers, 165 private pilots, and 58 commercial pilots—all of them trained in club flying schools. In France the flying-club movement has also developed on a large scale. There are at least nine regional clubs of the Aero-Club of France with a membership totaling close to 9000 individuals. In 1929 these members flew over 8000 hours.

The development of foreign flying clubs has in the past been a stimulus and guide to America and will no doubt remain so for some time to come. The rapid spread of small clubs throughout the country, however, in the past year indicates that America contains the possibilities of developing a system of flying clubs proportional to its size and wealth. The coming year should see more small clubs formed and the organization of many existing clubs into tighter and more efficient units. The building of private clubhouses at the great airports of the country should follow naturally and with far-reaching results. The flying club is important to American aviation: it is a powerful influence in leading people to fly and to learn to fly.

A few of the members of the Long Island Aviation Country Club, with a member-owned plane

OUR POINT OF VIEW

Naval Officers in Aviation

IN view of aviation's unquestionable importance in the defense of the country, it will doubtless come as a distinct surprise to most people to learn that there is a considerable lack of knowledge of it among the older officers of the Navy. As a result of this fact, it is said that a certain amount of prejudice exists today within the Navy itself.

The natural way to overcome this prejudice and increase the efficiency of the Navy in these days when all naval activities are so closely associated in some way or another with aviation, would seem to be to train as fliers some of the older officers who naturally exercise the higher commands. Personal knowledge of aviation coupled with their years of experience on the water would enable these seasoned men to exercise their commands more intelligently and efficiently in co-ordinating the activities of the fighting fleet with those of the air fleet.

It is claimed that the Navy Department excludes the senior officers from all opportunity to take the flight training course at the Naval Air Training Station at Pensacola this on an arbitrary basis whether or not they are physically and temperamentally qualified. It is the announced purpose to concentrate on younger officer pilots. At the same time, however, more than half the capacity of the training school at Pensacola is taken up by enlisted men and reserves on whom the government has only one to three years' claim at the outside. The thorough training there enables these men to qualify for positions in civil life at government expense.

Senior officers who are physically qualified, should not only be allowed to take this course, but should be forced to take it. It is believed that the efficiency of the Navy will suffer if the older officers who command it know nothing of aviation, and the only way they can understand it is through learning to fly.

Engineering Opportunities

TO the youth who expects to take up engineering but cannot decide in what branch of it to major, we suggest an investigation of the possibilities in highway engineering. Perhaps the fastest growing of the newer engineering fields, highway engineering concerns all the activities that have to do with the highway industry which has attained the rank of sixth of the nation's industries, financially.

With a production of over 5,000,000 motor vehicles and a total registration of 26,400,000 in this country last year, and a steadily increasing production each year, the need for more and better roads is impressively indicated. Registration of automobiles will grow at an amazing pace and highways must be built for them. For an indefinite period of years, there will be plenty of work for road builders, road machinery manufacturers, highway planners, cement and asphalt chemists, and others. The vast scope of the industry is of such a nature as to affect the daily life of practically every citizen of almost every country of the world.

Declining Conversational English

IS our coversational English or, more specifically, American language becoming debilitated through disuse? Many of us have thought so, but indications point that way more than ever if we are to judge by the results of an investigation conducted in New York City by American Telephone and Telegraph Company engineers who listened in on toll circuits over which business calls predominated.

Of the 79,390 words recorded, 30 simple words—principally the personal pronouns, prepositions, conjunctions, and a few verbs—made up nearly half More astonishing still is the fact that 155 words, including the 30 already mentioned, made up more than 80 percent. Purists and philologists will be horrified to learn that "shall" was heard only six times; while "yeah," "uh-huh," and "er" were plentiful; and the grunts and monosyllabic replies recorded ran into the thousands.

It has been remarked that this study shows a "facility of expression and economy of vocabulary" that is apparently held to be congruous with the rapid pace of our age. But to the thinking man, it is appalling, in that it shows an utter lack of imagination among business men, a lazy mentality that does not fit into the picture of modern efficient business. It is hoped that this sorry record, spoken into the telephone by New York business men, is not representative of the country at large. If it is, we are sure to retrogress. If we take up once again the grunting "speech" of our prehistoric forbears, the "culture" of the machine age may be set down in the histories of a future Renaissance in a hastily written paragraph or two!

Of the total 3,016,281 miles of highway in the United States, only 660,000 miles are surfaced—or slightly more than 20 percent. Fortunately our people are highway conscious and it is certain, therefore, that this percentage will rapidly mount. This is borne out by the fact that Congress passed this year, with rare speed, a bill for adding 50,000,000 dollars to the present 75,000,000 which is given the states to build highways in the Federal Aid Program.

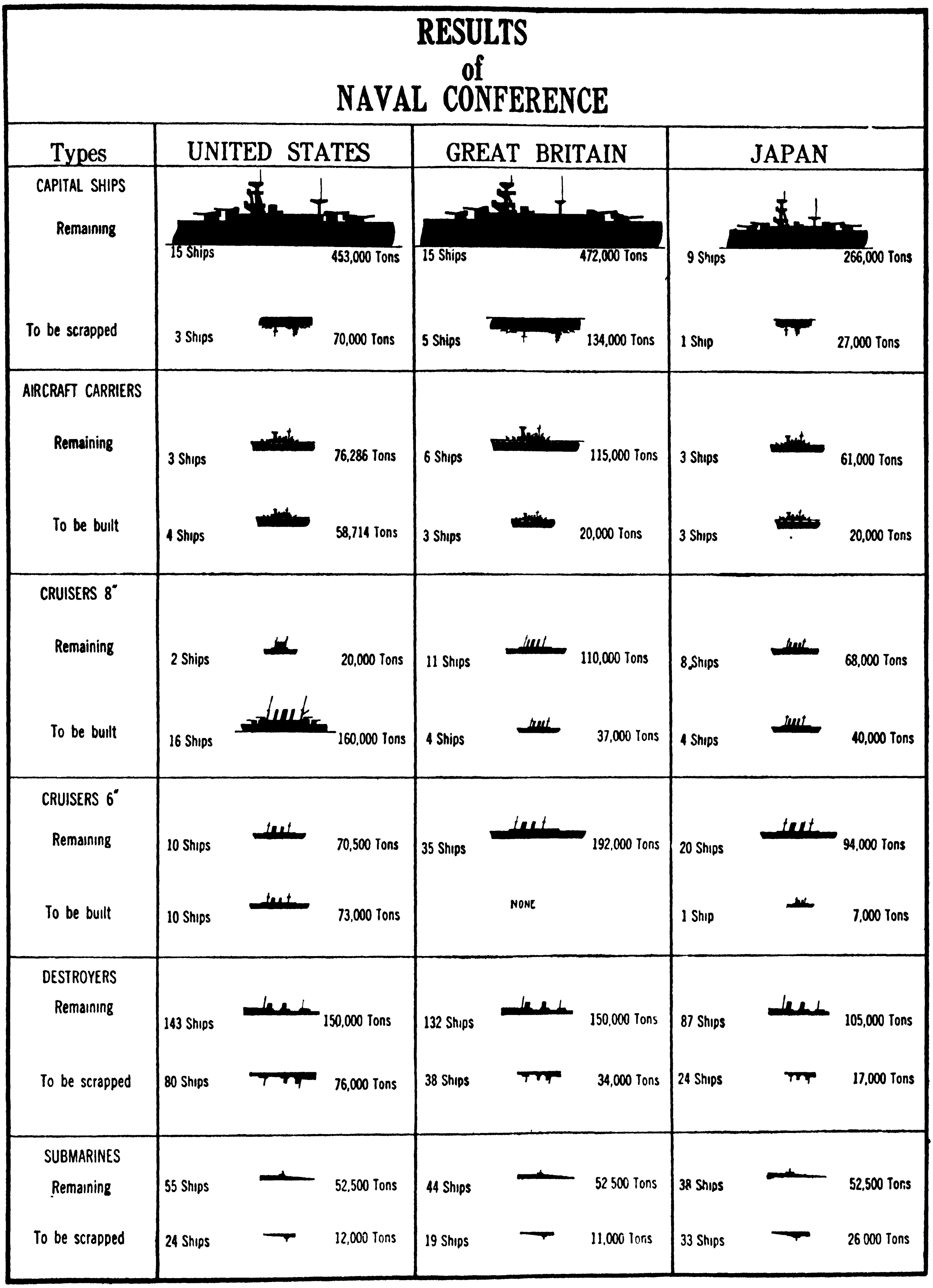
With so much work necessary on roads at home and an increasingly larger amount necessary abroad, it may be said without fear of contradiction that highway engineering today offers as fine a career as did electrical engineering in its early days—and with a decidedly wider field for the application of particular talents and aptitudes.

Analyzing the Naval Treaty

PRESIDENT HOOVER lost no time in transmitting the naval limitation treaty to the Senate. The Committee on Foreign Affairs and the Committee on Naval Affairs are giving immediate consideration to the treaty. They will scrutinize its provisions carefully and will hold extensive public hearings on the subject matter before giving their approval. The House Committee on Naval Affairs has demanded full information of the effect the treaty will have on the relative efficiency of our Navy. This consideration by Congress is essential. We are committing ourselves to an important agreement; no urgency demands the immediate approval of the treaty. The responsibility for our national defense rests on Congress; and it is the duty of Congress to examine minutely into all the aspects and ramifications of this treaty.

We confess that we are not enthusiastic over the part of the treaty fixing the ratios between Japan and the United States; we have the uncomfortable feeling that our delegation was embarrassed by our present naval inferiority and the Administration's eagerness for an agreement and could not properly support our country's position. In his prepared statement to the Senate Foreign Affairs Committee, Mr. Stimson tacitly admitted that, having already sacrificed our superiority in capital ships, we were handicapped throughout the negotiations. On the other hand, the position

(*Please turn to page* 70)



RESULTS of NAVAL CONFERENCE

Types	UNITED STATES	GREAT BRITAIN	JAPAN
CAPITAL SHIPS			
Remaining	15 Ships 453,000 Tons	15 Ships 472,000 Tons	9 Ships 266,000 Tons
To be scrapped	3 Ships 70,000 Tons	5 Ships 134,000 Tons	1 Ship 27,000 Tons
AIRCRAFT CARRIERS			
Remaining	3 Ships 76,286 Tons	6 Ships 115,000 Tons	3 Ships 61,000 Tons
To be built	4 Ships 58,714 Tons	3 Ships 20,000 Tons	3 Ships 20,000 Tons
CRUISERS 8"			
Remaining	2 Ships 20,000 Tons	11 Ships 110,000 Tons	8 Ships 68,000 Tons
To be built	16 Ships 160,000 Tons	4 Ships 37,000 Tons	4 Ships 40,000 Tons
CRUISERS 6"			
Remaining	10 Ships 70,500 Tons	35 Ships 192,000 Tons	20 Ships 94,000 Tons
To be built	10 Ships 73,000 Tons	NONE	1 Ship 7,000 Tons
DESTROYERS			
Remaining	143 Ships 150,000 Tons	132 Ships 150,000 Tons	87 Ships 105,000 Tons
To be scrapped	80 Ships 76,000 Tons	38 Ships 34,000 Tons	24 Ships 17,000 Tons
SUBMARINES			
Remaining	55 Ships 52,500 Tons	44 Ships 52 500 Tons	38 Ships 52,500 Tons
To be scrapped	24 Ships 12,000 Tons	19 Ships 11,000 Tons	33 Ships 26 000 Tons

RELATIVE tonnage, in the six fighting ship classes, of the three signatory powers to the London agreement. The situation on May 1, 1930, showing the amount of building and scrapping necessary to carry out the provisions of the agreement after its ratification—drawn to a relative scale. "To be built" includes all ships not 100 percent complete, as, for example, six of our 16 eight-inch-gun cruisers which are 60 percent complete. Obsolete ships, such as destroyers over 16 years old and submarines over 13 years old, are not included in "ships to be scrapped."

A good example of the effort expended in the state of Pennsylvania to make roadsides more attractive. A road intersection with mountain laurel, forsythia, and spirea

Courtesy Pennsylvania Department of Highways

Beautiful Roadsides

Move for Sightly Highways Is Becoming Countrywide

By Walter E. Burton

MILLIONS of American motorists who seek restful scenery, charm, and recreation on the open road are beginning to ask for better-looking highways. To a limited extent, their demand is being answered. But there is a surprising hesitancy of some states in making use of available public funds for highway beautification.

An act of May 21, 1928, gave authorization for the inclusion of tree planting as a part of federal-aid road construction. But, more than a year after the act became effective, the Bureau of Public Roads had received no request for aid in a single road-beautification program. This does not indicate that nothing has been done to increase the beauty of modern roads, for, on the contrary, considerable progress has been made in many states.

Signboards usually constitute the first objective of a road-beautification movement. All but 11 states exert some kind of regulatory influence over roadside signs, yet not one prohibits their erection. The situation is a ticklish one because it concerns personal property rights. Some of the larger advertisers have voluntarily abandoned roadside advertising, choosing to carry their message to the public through other channels.

"In practically all cases these roadside advertisements merely repeat, in the same form, appeals that are made quite properly and insistently through other agencies," Thomas H. MacDonald, Chief of the Bureau of Public Roads, stated in his last annual report. "They are not needed by the public, and are of doubtful value to advertisers. It is hoped that means may be found by suitable legislation to effect their complete elimination upon all roads constructed in part with money appropriated by the national government."

NEVADA is the only state having laws seeking to regulate the erection of signboards. No permit is issued for signs that will measurably mar the roadside beauty, or obstruct views. Connecticut regulates signs erected by filling stations and similar business places. Illinois controls erection of signs within right-of-way limits of trunk-line highways, but has difficulty with signs inside corporation limits. California issues permits only for signs located on the right-of-way adjacent to the business they advertise. Massachusetts keeps advertising matter 300 feet from the highway, except where it is contiguous to the business it concerns.

In recent years, with the rapid development of improved roads, there has been little attention given to their esthetic aspects. Lately, a few states, notably Massachusetts, California, Connecticut, Pennsylvania, and Florida, have begun to take the matter seriously. One surprising thing was learned: Road beauty is not a costly improvement.

By judicious planting of native trees, perennial flowers, and shrubs along rights-of-way; by removing objects that are in themselves ugly; by restricting sign-board placing; and by a few other simple processes, a plain or a downright ugly road can be converted into a thing of lasting beauty.

Massachusetts, which started improving the beauty of its roads in 1921, frequently is pointed out as a model for other states. The State Department of Public Works has charge of the work. When a new road is built, it is made wide enough to permit landscaping. The maintenance division does the actual work. At Palmer is a state nursery for the propagation of trees and shrubs. This also is a training station for men who care for the plantings.

The first step in the work is the preservation of trees and plants already established. Maintenance men remove dead trees and cut stumps six inches below the ground, trim away dead or broken limbs, treat wounds by trimming and filling with tar, repair cavities by approved methods of tree surgery, and re-inforce split

Courtesy Massachusetts Department of Public Works

A group of birches bordering a New England road. Thinned out and trimmed, they increase the scenic value and do not obstruct the view

and weakened parts with cables. Undesirable branches, such as those which rub together, are removed. When advisable, trees are sprayed.

Vistas are developed by trimming away underbrush and removing obstructing trees. Roadside springs are cleaned and made usable. Seats are provided at convenient points, and rubbish barrels are placed at strategic positions.

In new planting, only domestic trees and shrubs are used. Gravel and sand slopes are a constant source of trouble because of water erosion. They are treated by planting small pines, sweet ferns, and other suitable vegetation. Whenever there is enough soil of the proper kind, grass or shrubs are planted. Extensive tree and shrub planting is confined to new roads 60 or more feet wide, so that there will be little or no subsequent widening operations to destroy the beauty. Shade trees are planted in groups, not in monotonous, military lines.

THE procedure followed in landscaping is systematic. After construction is complete, a man trained in landscape planning locates with colored pencils on a blueprint the positions of shrubs and trees. Stakes are then placed on the area being treated, to indicate the plan of digging. Dynamite is used for forming holes because it loosens the ground over a considerable area, and is about half as costly as manual or machine digging. High-grade soil is used to fill the pits. An order for planting material is sent to the nursery, and the supplies are delivered by trucks. After new shrubs are planted and well established, a final grubbing is carried out.

California considers both beauty and practical aspects of roadside improvement. Trees are planted; native wild ferns, shrubs, moss, trees, and flowers are preserved; and weed areas attacked. For utilitarian reasons, dry grass is burned, and obnoxious weeds such as the puncture vine, yellow star thistle, and mustard weed, are removed. The initial cost of tree planting is largely borne by civic and other groups, but maintenance is carried on by the state. Periodic watering of trees frequently is necessary.

Pennsylvania is one of the most recent converts to the idea of highway beauty. In 1928 a forestry unit, consisting of five trained foresters and three landscape architects, was created to act under the highway forester. Field men are located in eight state districts, and their duties are to plant and care for shade trees, plant slopes and evergreen snowbreaks, and create open views.

Courtesy State Road Department of Florida

Artificial aids to safe motoring such as these neatly constructed guard rails can also be made very attractive

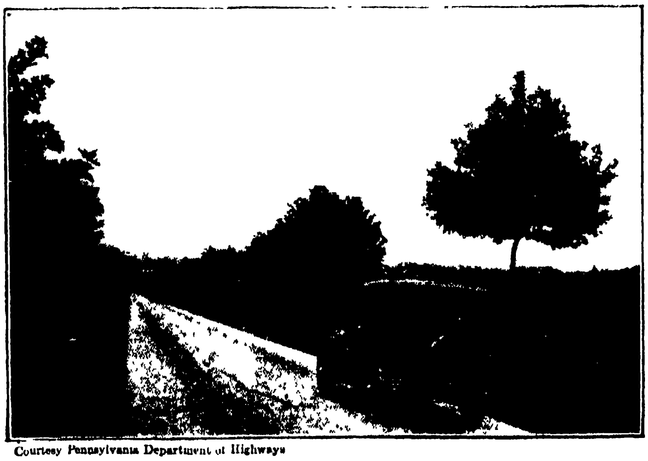
Outside organizations have helped considerably since the work started, by providing trees and shrubs.

In general, the ideas used in the majority of states which give attention to highway beauty are similar. In Florida, however, the conception of beauty is somewhat different. This is largely because of the peculiar quality of Florida's semi-tropical scenery. Officials believe that the most beautiful landscape in the state consists of a well-paved road, with ditches and slopes planted in grass and carefully groomed, and with the characteristic Florida scenery forming a background on each side. Rubbish is kept cleared away, and planting of large trees and shrubs along the right-of-way is not encouraged.

It is pretty well agreed that there are few ways in which a greater return, dollar for dollar, can be obtained with public funds than by spending a little more for beautifying highways. Aside from the purely esthetic aspects of the work, roadside property values invariably are raised. A beautiful road creates a better sense of self respect in the community, and it favorably impresses the visitor who, besides bringing a measure of profit to local business when he is persuaded to linger, carries away for distribution to other places impressions which he gained in passing through.

Courtesy Massachusetts Department of Public Works

To some, a paved road is but an artificial scar across the country, but if it is well kept, it may become a thing of beauty. The shoulders in this case are sodded and clean



Courtesy Pennsylvania Department of Highways

Oriental plane trees seven years after planting. The planting of these was carefully done so that they took root firmly and but little further care was necessary

Planet X

By Henry Norris Russell, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THE widespread and justified sensation caused by the discovery of the new major planet of our solar system will have passed long before these words will have reached America much less see the light in print. But the discovery itself is so important and illustrates so well the methods of modern astronomy that it should not fail to be set out in order here.

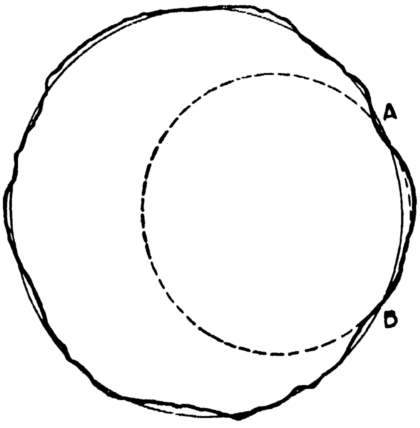
Everyone knows how the last great planet to be discovered was found. After Uranus had been known for half a century or more it was found to deviate from the orbit determined from the first 50 years of observations, after full allowance had been made for the attraction of the then known planets. Some unknown body must be pulling at it and this could only be a planet still farther from the sun. To calculate from the observed perturbations of Uranus' motion the orbit of the unknown planet which produced them was a very intricate matter. But the problem was solved by LeVerrier in France, and Adams in England, and the planet Neptune was found within a degree or so of the place in the heavens which these calculations pointed out.

Through all the 84 years since the discovery of Neptune until the present, the possibility that there was a still remoter planet has been realized, and now that it has been discovered the layman naturally may ask, "Why, if it was there all the time, did not the mathematicians tell us where to find it?" As a matter of fact they did, but through no fault of theirs their answer could not be as precise as it was for the earlier problem of Neptune.

To calculate the perturbations produced in the motion of one planet by the attraction of another is no small task, even when the orbits of both are accurately known in advance; and to work backward from the perturbations of a known planet to the orbit of an unknown one is much harder. But mathematical astronomers are used to hard problems and know how to solve this one. The worst difficulty is that to find the perturbations we must compare the observed positions of the known planet with those which it *would have had* if the unknown planet had not been attracted. To determine the latter is evidently difficult.

To see how it can be done let us ignore the attractions of the known planets (or suppose that, as in practice, their effects have been calculated and allowed for). We then know that, barring unknown influences, the planet should move in an exact ellipse about the sun in accordance with Kepler's familiar laws. What the size and shape of this ellipse may be can be found only by observing the planet. If no extraneous forces are acting, the planet will follow the same ellipse time after time, but if an unknown planet is perturbing it the tracks in the second and subsequent revolution will not be quite the same and the differences will reveal the amount and nature of the perturbations.

It is not actually necessary to wait quite so long. When a planet has been well observed half around its orbit its motion along the other half can be predicted closely enough to reveal any considerable disturbances after it has been followed in this half as well. But something like a full revolution around the sun is really necessary. With observations covering only half the orbit or less, it is possible to find a "fictitious orbit" such that a planet moving in it without perturbations (save by the attractions of known bodies) will, *over the given interval of time*, always be very near the real planet—subject though it is to additional perturbations, and though in earlier or later years this will not be true.



Why it is easy to go wrong in the prediction of planets—see the text

It may help to understand this to imagine a circular hoop which has been bent and battered a little out of shape (see drawing). If we can see the whole hoop or half a photograph of it it is easy enough to strike a true circle which follows its general course, and then find the amount of the deformations from point to point. But if our photograph covers but a small part of the hoop and we try to fit a circle to it as best we can, we may draw it too large or too small, according as this particular part of the hoop has been flattened or bent too sharply.

The heavy line in the drawing represents a battered hoop which in a rough way illustrates a perturbed orbit. The circle represents the hoop before it was deformed, or the unperturbed orbit. But if we knew only the part AB of the hoop we would suppose that the whole was like the dotted circle and would greatly underestimate the amount, and sometimes even the direction, in which this portion had been bent out of shape. In quite the same way we can not get any accurate idea of the perturbations of a planet unless we have observations extending pretty well around the orbit.

Now since its discovery in 1846 Neptune has been only half way around its orbit and it is therefore practically valueless for locating an outer planet by means of its perturbations. Uranus has completed two revolutions since its discovery and is fully available, but it is nearer the sun and farther from the trans-Neptunian planet and the perturbations to be anticipated are therefore small.

Several investigators have examined the question, the most comprehensive work being probably that of the late Dr. Percival Lowell which was published in 1914 but commenced more than a decade earlier. A careful mathematical investigation indicated the existence of small perturbations just within the limit of detection, and indicated that the unknown planet which produced them must be either in the direction of the constellation Gemini or just on the opposite side of the sun. The perturbations produced by planets in these two positions were so much alike that no decisive choice between the two could be made.

Lowell estimated the new planet's distance from the sun as 43 to 44.7 astronomical units (see illustration, page 22, section 9, a' and a'. *Ed.*) half as much again as Neptune's—and its mass as 1/50,000th that of the sun, six times the earth's, but only one third of that of Uranus or Neptune.

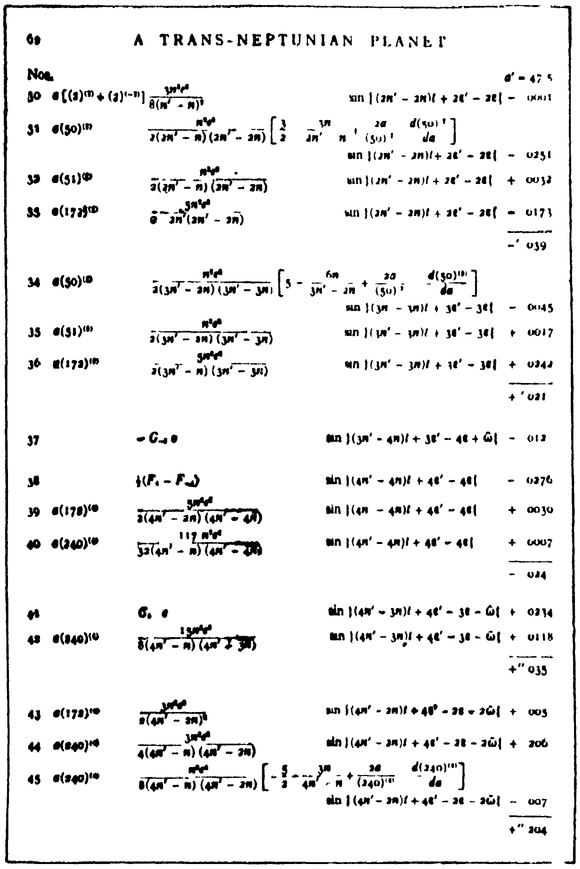
Accepting these conclusions the next question was, how to find the planet. Being less massive than Neptune it was doubtless smaller, and being far from the sun it must be faintly illuminated and far from conspicuous. Lowell estimated its probable brightness as from the 12th to the 13th magnitude (see illustration, page 22, section 10-- *Ed.*). It is hopeless to search for such an object visually among the multitudes of stars and the only chance of success is by photography, employing substantially the same methods as have been proved so successful in finding asteroids; that is, the careful comparison of suitably duplicated plates of the same star fields.

A great deal of time and labor was thus spent by Dr. Lowell and his successors at the observatory which he founded at Flagstaff, Arizona, and which bears his name. In time it became clear that the distant planet was probably fainter than the original estimate, which in the nature of the case could only be very rough, and that a very powerful instrument would be required to find it. A gift from the President of Harvard, Percival Lowell's younger brother, provided an admirable instrument. It possesses a triple objective of 13 inches aperture which gives sharp star images over a wide field, and is withal very rapid.

THE new Lawrence Lowell telescope within a year of its installation has brought the long-sought planet to light. Photographs of moderate exposure covering the whole region of the heavens around the predicted position were obtained and on one of them, taken on January 21, 1930, Mr. Tombaugh of the observatory staff found "a very promising object." It was identified from its motion past the numerous fixed stars as revealed on plates of the same star field while being compared under the blink comparator. This showed that one faint star among many thousands had shifted its place by a certain expected order of distance, in the interval between the taking of the two plates. Since that date it has been carefully followed both photographically by Dr. Lampland with the 40-inch reflector and visually by E. C. Slipher and other members of the staff. Its motion in the heavens has been just what might be expected of a trans-Neptunian planet at about the distance anticipated by Lowell, and its longitude agrees closely with his predictions. There is no doubt that it is actually a new major planet much farther away than any which has previously been known.

This admirable discovery comes to the astronomers at Flagstaff as a reward of years of skillful development of methods and patient work. It is most gratifying that this long and devoted search has been crowned with full success, though we must all regret that the originator and inspirer of the campaign did not live to witness its triumphant close.

What of the new planet itself? Full knowledge comparable to that which we have regarding the other planets of our system can come only after years of further work. For example, it will be a long time before its orbit is accurately known. A fairly good orbit of a rapidly moving asteroid can be derived from three good observations separated by intervals of a week or so. For this slowly moving body intervals of a couple of months will be desirable. Before it was lost in the light of the sun, which happened in May, sufficient data to give a good preliminary orbit which will tell us where to look for the planet at the end of summer when it can again be observed, was worked out and published (April 12). Next year's observations will permit a considerably better determination; and so on.



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Giving an idea of modern mathematical planet predicting—a typical page from Lowell's original prediction of 1914. There are many pages like this

Even after a decade, however, we will have observations covering only a very small fraction of the orbit and will still be somewhat in the position of having to determine the course of a whole circle from a small arc. It may happen that, calculating backward, the images of the planet can be found on photographs taken years before it was discovered, though it is so faint that the chance is not very good. And in this case the arc available for determining the orbit, and the calculated results, may be increased. At this early date we can be certain only that the planet is near the ecliptic, that it is moving around the sun in the same direction as the other planets, and that the inclination of its orbit plane, while greater than the other planets, as Lowell predicted (section 11. -*Ed.*) is not extremely great. The general agreement of its apparent motion with that calculated with Lowell's estimated distance of 43 to 44.7 astronomical units shows, however, that this prediction is near the truth.

Adopting provisionally this distance, which is 50 percent greater than Neptune's, what else can now be said about the planet? Its diameter must be rather small. With the 24-inch refractor at Flagstaff the planet appears as a faint stellar point and shows no sensible disk.

IF it were really as much as 10,000 miles in diameter it would show an apparent disk of 0".5, which the experienced observers who have examined it hardly could have missed under favorable conditions. We may conclude with some confidence therefore that the new planet is little if at all larger than our earth—provided, to be sure, that the estimate of its distance here adopted is correct.

Further evidence that the planet is a small one is found in its faintness. The assigned magnitude, about 15.5, is photographic. If it is of the average color of the inner planets it should be about a magnitude brighter visually than photographically, and we may base our estimates on a visual magnitude of 14 or 14.7. This makes the planet only about 1/250th as bright, apparently, as Neptune. If Neptune could be removed to this greater distance it would look only 1/5 as bright as it does now, but even so it would outshine Planet X fifty-fold. This suggests that the diameter of the new planet is about 1/7 that of Neptune, or a little less than 3000 miles. This estimate, however, may be too small, for Neptune has the highest superficial reflecting power, or albedo, of any of the planets and a planet of lower albedo would have to be larger to reflect the same amount of light. To go to the opposite extreme we may take for comparison the moon which has about the lowest known albedo. A simple calculation shows that if removed to a distance of 45 astronomical units from us and from the sun, she would appear as a star of visual magnitude 17. Planet

Percival Lowell

X appears three magnitudes or 16 times brighter, which on this hypothesis regarding its surface brightness makes its diameter four times that of the moon, or 8600 miles. It is probable that the truth lies between these two estimates, but little more can be said for there are very great differences of albedo even among the atmosphereless asteroids, and we have no means of estimating more closely what value we should use for the new planet. It may be considered, nevertheless, that it is fairly comparable in size with the four inner planets of our system, and much smaller than the four outer ones which were previously known.

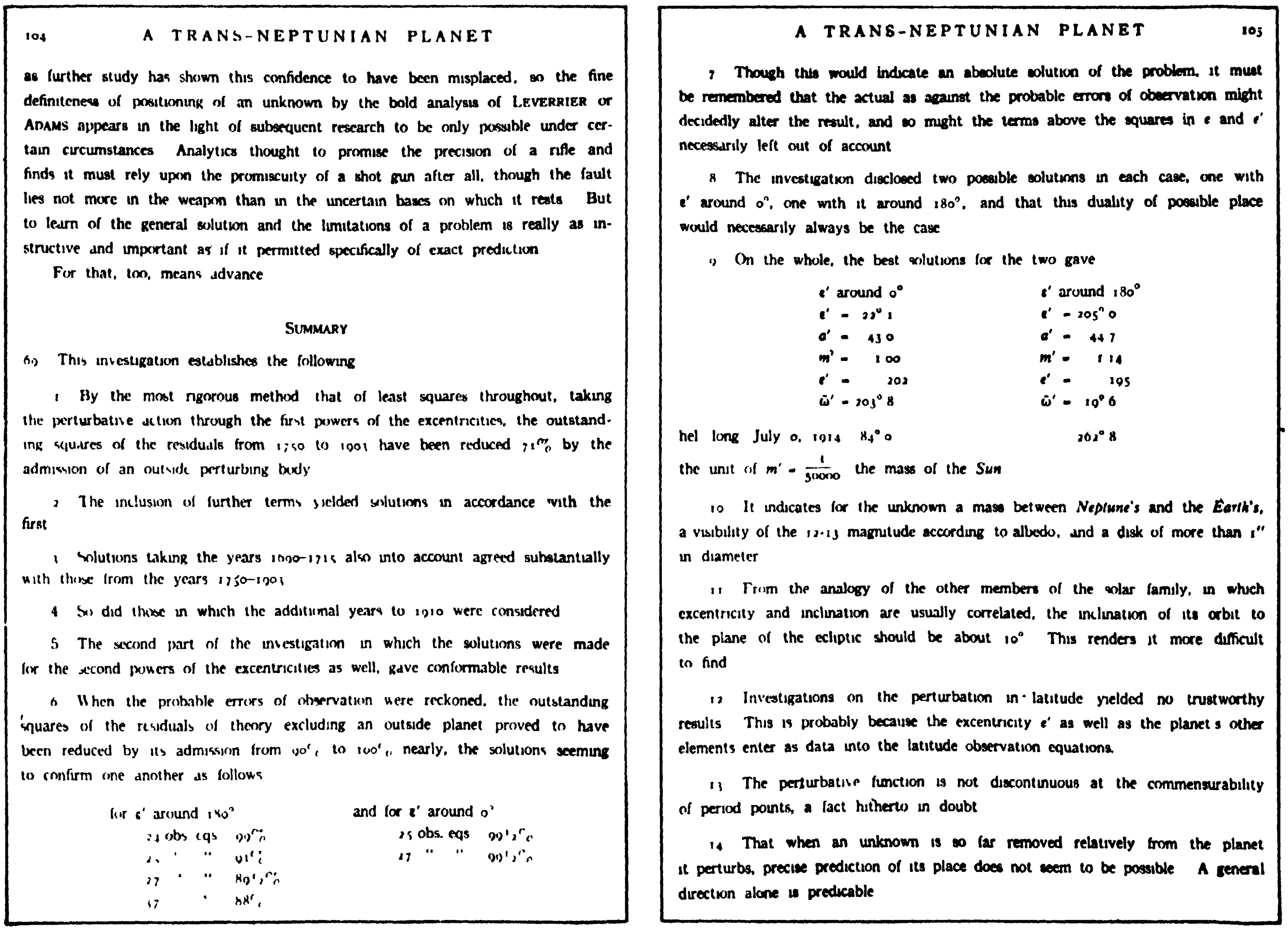
The planet's mass can probably be determined at least roughly from the perturbations it produces in Uranus and Neptune when once its orbit is accurately known. The latter statement may seem inconsistent with what has already been said, but the problem here is not quite the same as before. Suppose that, in the drawing, we knew the direction in which the wavy line deviated from the circle at each point and the relative though not the absolute amounts of these deviations. We would then have much less latitude in drawing our theoretical circle than before, and could be fairly sure of its position in cases which before were hopeless, as explained on page 20.

A planet less than 10,000 miles in diameter would be very unlikely to have a mass 1/50,000 that of our sun (section 9. *Ed.*) for this would demand a mean density about 17 times that of water. The earth's mass is only 1/330,000th of the sun's, and if Planet X is no more massive it is hard to see how its attraction could produce the effects studied by Lowell. This discrepancy would be diminished if the planet's distance from the sun should turn out to be greater, but it is premature to discuss the matter further at *present, without more dependable data.*

The only hope of learning anything about the rotation of the new planet is by photometric means. If, like many of the asteroids, it should show regular periodic changes in brightness, these would reveal the rotation. But for so faint an object, the observations would be difficult.

Finally, there is little hope of detecting a satellite of the planet unless, like our moon, it should be almost comparable in size with its primary. Nevertheless it is probable that photographs will be made with the great reflectors, in order to investigate.

In conclusion, two tributes must be paid where honor is due: First, to the skill, assiduity, and devotion of the workers at the Lowell Observatory who have made this important discovery; and second, to the memory of Percival Lowell, traveler, man of letters and affairs, and observer of the planets. He did many things in the course of a crowded life and did them well. The mathematical researches took him outside his other fields of work and into a region full of traps for the unwary, yet the discovery of this new planet has justified him by his works despite the doubts of many of his contemporaries. His fame bids fair to increase as the years pass on.—*Athens, Greece.*



A photographic reproduction of the final two pages - the summary—of Lowell's original prediction, published 1914 as Memoir No. 1, Volume 1, of Lowell Observatory. Forgotten by the world, it never was forgotten by the persistent Lowell Observatory Staff. Copies of the original memoir are now very rare

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as further study has shown this confidence to have been misplaced, so the fine definiteness of positioning of an unknown by the bold analysis of LEVERRIER or ADAMS appears in the light of subsequent research to be only possible under certain circumstances Analytics thought to promise the precision of a rifle and finds it must rely upon the promiscuity of a shot gun after all, though the fault lies not more in the weapon than in the uncertain bases on which it rests But to learn of the general solution and the limitations of a problem is really as instructive and important as if it permitted specifically of exact prediction

For that, too, means advance

SUMMARY

69 This investigation establishes the following

1 By the most rigorous method that of least squares throughout, taking the perturbative action through the first powers of the excentricities, the outstanding squares of the residuals from 1750 to 1903 have been reduced 71% by the admission of an outside perturbing body

2 The inclusion of further terms yielded solutions in accordance with the first

3 Solutions taking the years 1690–1715 also into account agreed substantially with those from the years 1750–1903

4 So did those in which the additional years to 1910 were considered

5 The second part of the investigation in which the solutions were made for the second powers of the excentricities as well, gave conformable results

6 When the probable errors of observation were reckoned, the outstanding squares of the residuals of theory excluding an outside planet proved to have been reduced by its admission from 90% to 100% nearly, the solutions seeming to confirm one another as follows

for ε' around 180°			and for ε' around 0°		
24	obs eqs	99%	25	obs. eqs	99½%
25	" "	91%	37	" "	99½%
27	" "	89½%			
37	" "	88%			

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7 Though this would indicate an absolute solution of the problem, it must be remembered that the actual as against the probable errors of observation might decidedly alter the result, and so might the terms above the squares in e and e' necessarily left out of account

8 The investigation disclosed two possible solutions in each case, one with ε' around 0°, one with it around 180°, and that this duality of possible place would necessarily always be the case

9 On the whole, the best solutions for the two gave

	ε' around 0°	ε' around 180°
ε' =	22° 1	205° 0
a' =	43 0	44 7
m' =	1 00	1 14
e' =	202	195
$\bar{\omega}'$ =	203° 8	19° 6
hel long July 0, 1914	84° 0	262° 8

the unit of $m' = \frac{1}{50000}$ the mass of the *Sun*

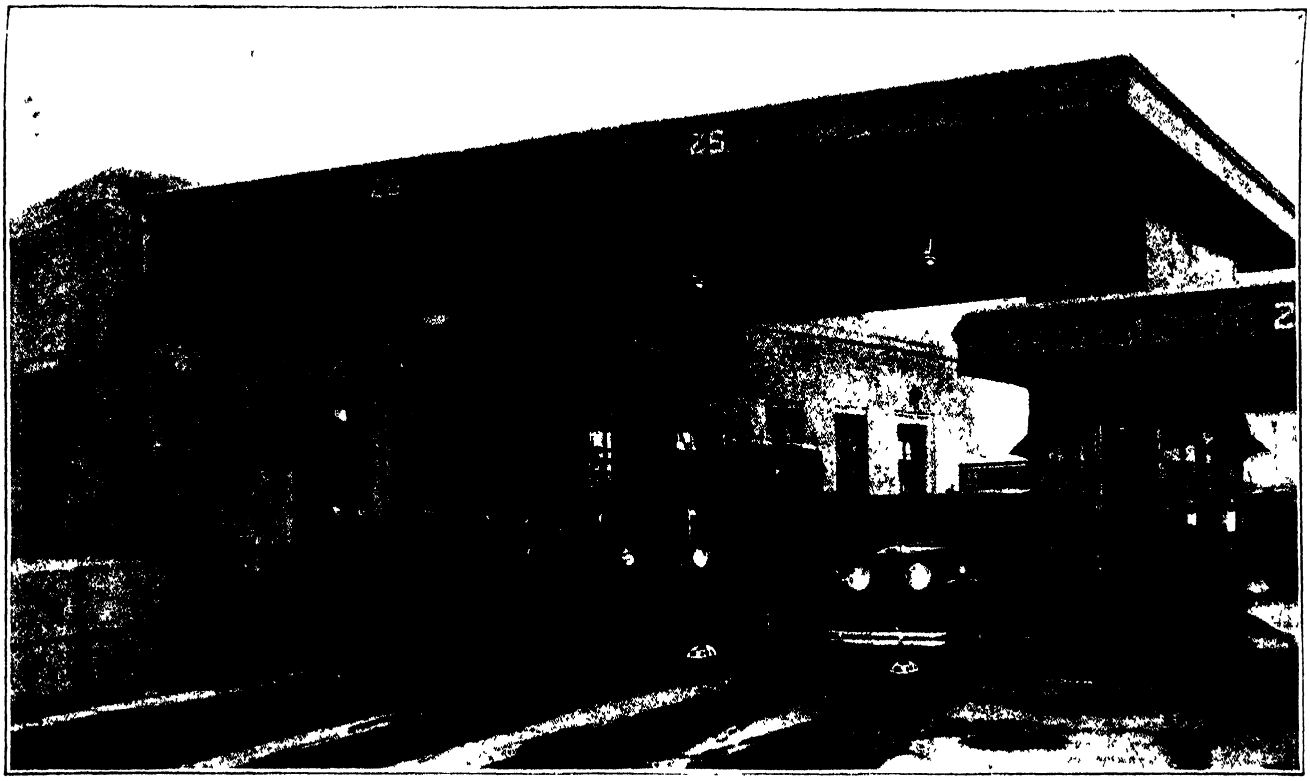
10 It indicates for the unknown a mass between *Neptune's* and the *Earth's*, a visibility of the 12-13 magnitude according to albedo, and a disk of more than 1″ in diameter

11 From the analogy of the other members of the solar family, in which excentricity and inclination are usually correlated, the inclination of its orbit to the plane of the ecliptic should be about 10° This renders it more difficult to find

12 Investigations on the perturbation in latitude yielded no trustworthy results This is probably because the excentricity e' as well as the planet's other elements enter as data into the latitude observation equations.

13 The perturbative function is not discontinuous at the commensurability of period points, a fact hitherto in doubt

14 That when an unknown is so far removed relatively from the planet it perturbs, precise prediction of its place does not seem to be possible A general direction alone is predicable



A toll house showing photoelectric cells in roadbed and lights overhead

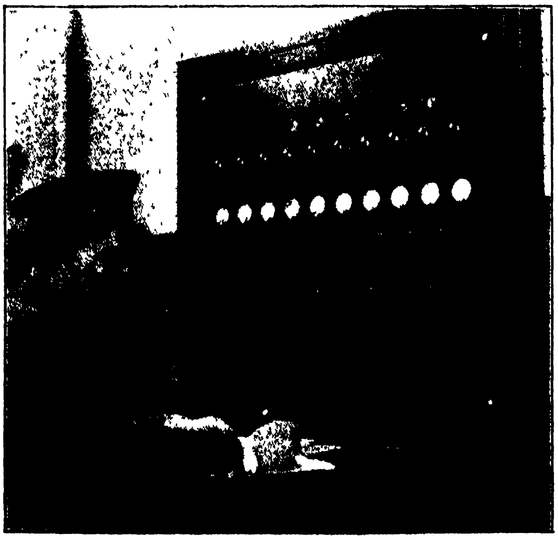
Light Counts Cars on Bridge

THE task of checking and controlling traffic over the longest span bridge in the world is being accomplished by means of photoelectric cells and light beams. The man who superintends traffic control on the new Ambassador Bridge over the Detroit River at Detroit can tell, by glancing at his control board far from the scene of operations, which traffic lanes are in operation, whether the density of traffic warrants the use of more or fewer lanes, and whether the vehicles are being cleared over the bridge efficiently. The system was devised and installed by Benjamin Cooper, a consulting engineer of New York City.

A photoelectric cell is imbedded in each of the 10 lanes provided for incoming traffic, at the point where cars must stop for payment of tolls. While the car is stopped, it intercepts a beam of light from a source in the ceiling of the toll shed. This interception causes the cell to function and it, in turn, causes a magnetic counter to register a count and also causes an indicator light to go out.

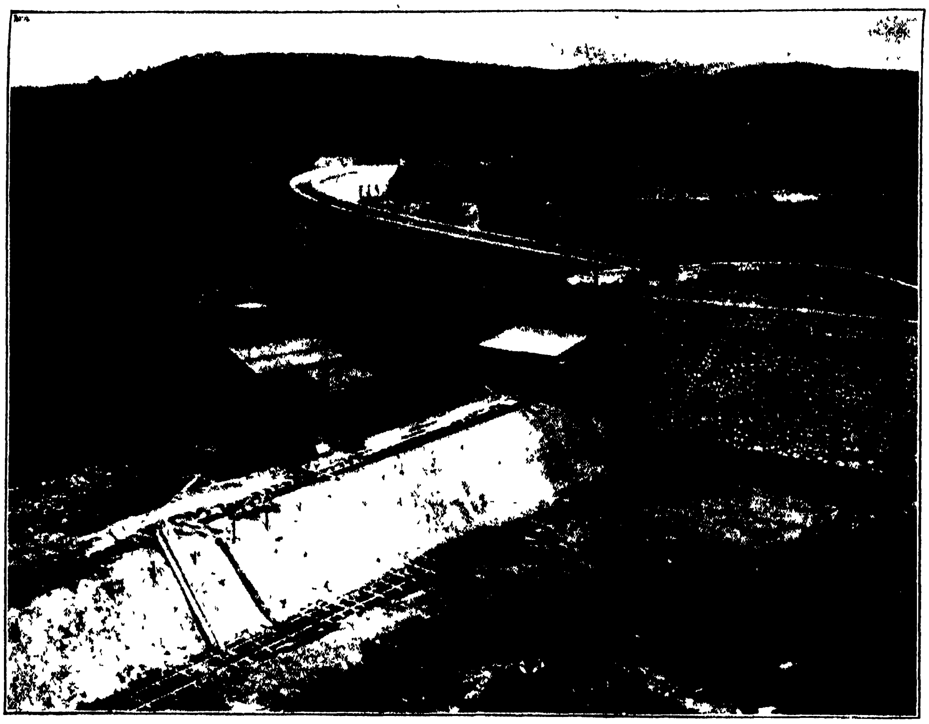
The frequency with which the indicator lamp goes on and off shows the traffic density for a particular lane. At the end of a working period, the number of tolls recorded by the cash registers must check with the count shown by the cell-operated registers.

The wires that are connected to the photoelectric cells are carefully shielded from all external electrical disturbances and carried underground to the operating panel located in the toll supervisor's office. The cells are so located in the roadbed as to minimize the effect of mechanical vibration due to passing vehicles, and so shielded as not to be interfered with by outside lights. This task of protecting the cells was particularly difficult because they are in the open and because the current through them is rated in millionths of an ampere.



The toll supervisor sits before the panel-board in his office hundreds of feet from the toll sheds and keeps close tab on the movement of traffic

The photoelectric cell in the roadbed and the light source overhead



Upstream face of the Marathon Dam showing, in the foreground, the spillway under construction

Water Runs From Marathon to Athens

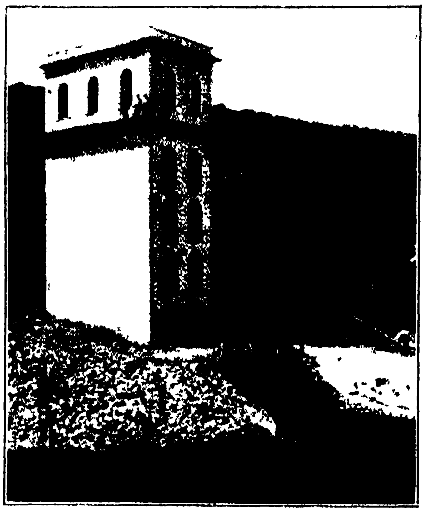
By F. D. McHugh

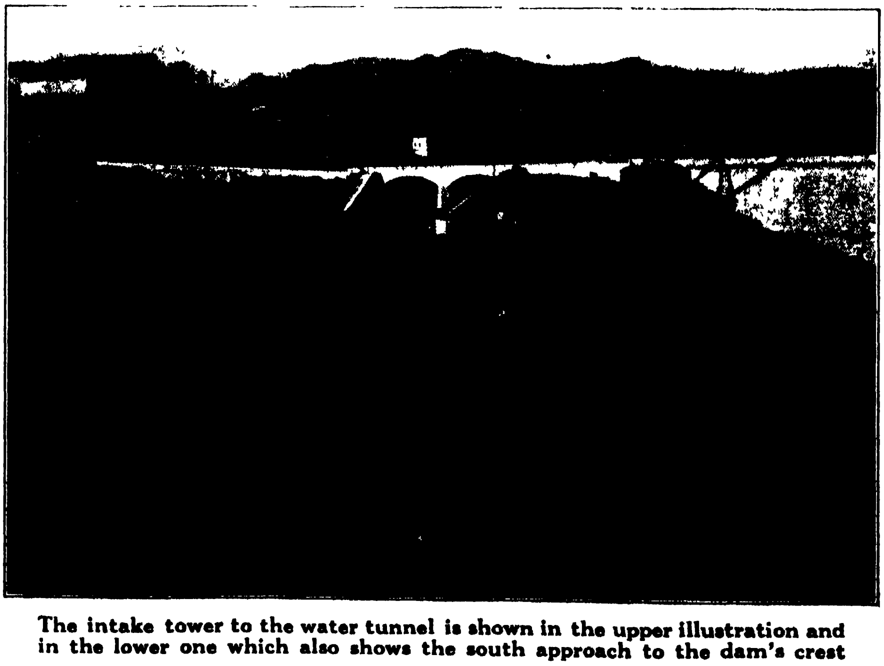
ABOUT four miles from the plains of Marathon where, in 490 B.C., the combined forces of Athenians and Plataeans numbering perhaps 10,000, won a decisive and famous victory over an invading force of approximately 50,000 Persians, a celebration of unusual importance took place last October in the presence of a large gathering including the Greek President, the Premier, and other notables. The occasion was the dedication of the Marathon Dam, construction of which had just been completed by Ulen and Company, an American engineering firm.

AS dams go, this new one presents no striking departure in construction, and in respect to size, it is far from outstanding. Its bid for fame rests upon the facts that it is practically a mass of marble, that water from it is carried through a 1900-year-old aqueduct, that it is situated in a region rich in historical associations, and that it is an important part of a very important project. Its completion marks the first big step of a plan, costing upwards of 11,000,000 dollars, to solve the age-old problem of providing an adequate supply of water for the city of Athens and environs.

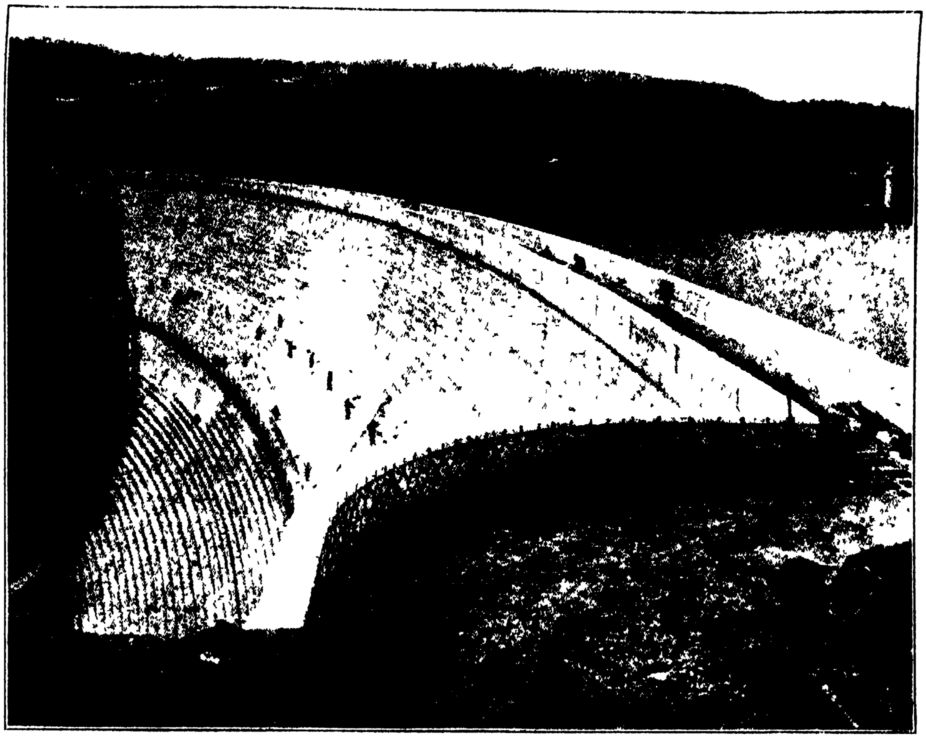
One of the oldest cities of the world, Athens has been sorely pressed for water since its foundation on the sacred rock in 1259 B.C. So dry, in fact, has the Attic region always been that Aristophanes, Strabon, and Pausanias commented upon it in their writings. During Athens' early days, local springs, like the Kalirhoe with its nine spouts (Enneakrounos) and wells like the Klepsydra on the Acropolis, formed the only source of water supply. In time, the underground waters of Mount Hymettus were carried in subterranean aqueducts to the city. Yet the supply was still inadequate for, in 594 B.C., Solon found it necessary to enact strict laws regulating its use.

With the decline of ancient Greece, the Romans tackled the problem and solved it by constructing the famous Hadrian Aqueduct about 115-130 A.D. This





The intake tower to the water tunnel is shown in the upper illustration and in the lower one which also shows the south approach to the dam's crest



Downstream face of dam from north end showing intake tower to tunnel at extreme right and men giving the marble a final cleaning

system brought water from the Pentelicon and Parnes ranges and for centuries the supply was adequate. Invasions of Goths, Vandals, and Slavs then came one after the other, and finally the country was occupied by the Turks. Amid the confusion caused by these disturbances, the aqueduct began to crumble, gradually fell into disuse, and was forgotten. Rediscovered in 1840 it was repaired and became the city's chief source of supply.

With the destruction of Smyrna in 1922 by the Turks and the driving of all Greek nationals from the territory, refugees crowded into Athens. As its population of 300,000 increased almost overnight to 800,000, the question of water supply again became acute. The government at once began consideration of various schemes and the "Marathon Project" was finally decided upon. Of this project, the Marathon Dam is the major part. Its water will flow by gravity to a storage reservoir on the Attic Plain near Athens and will be distributed from there. A secondary and separate part of the scheme is the 23½-mile pipe line through which sea water is pumped from historic Phaleron Bay for sprinkling the streets. The use of this salt water makes available more than 130,000 gallons of potable water daily--water which was formerly used for street sprinkling. Rehabilitation of existing systems was included in the provisional contract which the Hellenic Republic signed, work on which has now been completed and accepted by the government. It is expected that the entire scheme will be complete in 1931.

◄ Interior view of ancient Hadrian Aqueduct, repaired and enlarged

▼ Laying 36-inch siphon line to Athens. Ruins of the old Roman aqueduct may be seen at right

The Marathon Dam is a gravity section structure but was built on an arc radius of 1312 feet, is 174 feet high and almost 1000 feet wide along its crest. A spillway for the overflow was cut into the hill at the south end, and through its base are pipes for completely draining the lake.

WORK was begun in January, 1927, and the first concrete poured 11 months later. As has been noted, no extraordinary engineering problem was presented, but the material used in the dam is unusual. It is faced, on both the upstream and downstream sides, with Pentelic marble from the quarries nearby from which marble was taken for the famous buildings and sculptures of ancient Greece. This facing is laid in a beautiful mosaic of marble blocks in cement mortar so that the effect is very nearly that of a giant honeycomb. It is said to be the only mosaic marble-faced dam in the world. Even the sand and aggregates used in the concrete filling were ground from the same marble.

The old Hadrian Aqueduct was enlarged and repaired at several places for carrying water in this new system, and portions were extended to carry a supplemental supply.

The Pilot 'Phones His Airport Via Radio

By Harold Crary

Edmund T. Allen, who tells here of a pilot's experience with radio in an airplane

THE urgent need for radio equipment on aircraft has long been recognized by authorities in the air transportation business. With larger patronage of airmail and express, and demand for rigid adherence to schedules—and uncertain or bad weather is the chief foe of schedules—and with rapid branching out into passenger-carrying activities, the operators bend every energy to get workable radiophone equipment.

In the past, it has been necessary for the pilot to take off and fly into weather about which he knew practically nothing because it was constantly changing. Also the management was completely out of touch with the craft until it appeared at the terminal field or was forced to return due to the bad weather. If the airplane did not appear after a reasonable time had elapsed, a search had to be organized to comb the country for hundreds of miles to locate the scene of the forced landing.

Now several leading lines have authorized expenditures for necessary ground radiophone stations, hiring of operating personnel, and installation of equipment in the planes. Of these lines, the Boeing System carries passengers as well as mail, and its large-scale operations made it necessary to utilize every known aid to aircraft. Consequently it worked vigorously to perfect the radiophone. The initial use of the radiophone leads to the following positive conclusions as to its benefits:

It adds much to the safety of flying; reduces number of emergency landings due to uncertainty as to weather ahead; enables pilots on regular routes to complete a larger number of scheduled trips on time; and increases the pay load of mail, express, and passengers by reducing the amount of excess gasoline now carried to give the pilot ample cruising radius when he is uncertain as to weather. The radiophone is also of considerable value in dispatching planes and giving orders to pilots in the air.

Edmund T. Allen, whose 6000 hours in the air have included 4000 hours with the airmail, both night and day flying, on the transcontinental route, describes talking to a radio telephone station 150 miles away and several thousand feet "down" in this way:

" 'HELLO, Ed!' It is the voice of the Boeing superintendent in my ear phones. 'We have 1100-foot ceiling over the airport. Visibility five miles, barometer slightly below normal, but steady; no change in 30 minutes. Where are you?'

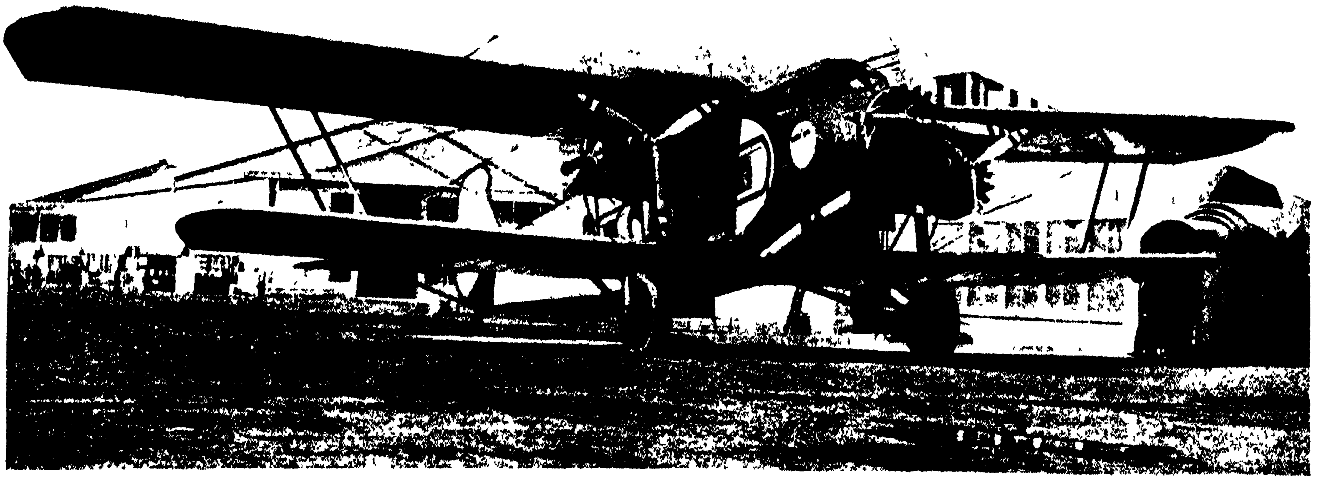
" 'Thirty miles out and making 115 miles per hour ground speed. How's the weather half way between here and there?'

" 'Same as here,' he answers. 'Fog begins at Summit and ceiling rises as mountains drop away. You are five miles south of the course. We will send up a yellow parachute flare when you arrive within three miles of us. What is the altitude at the top of the cloud layer?'

" 'Eighty-eight hundred,' I tell him. 'That gives 1500 feet thickness. Will arrive about 9:13. Shoot rocket at 9:11. Send it vertical to give me exact location. I will jazz my motor on the way down. Listen for it and tell me if I am overshooting. Where is the second section?'

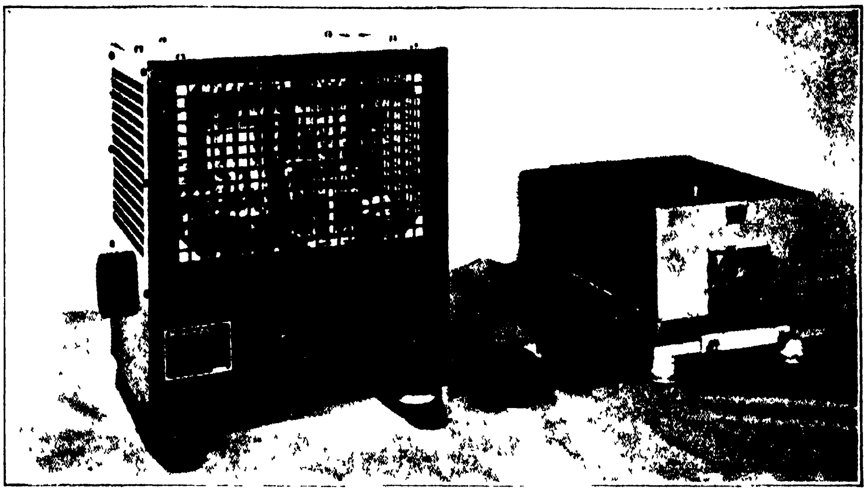
" 'John is 70 minutes behind you and is still talking with the other terminal. First section of the westbound is due about same time as you are. Have instructed him to slow down and stay away from the airport until you are down and we tell him to come in. You are still a little south of the course. Five degrees more to the left ought to bring you right over us.' "

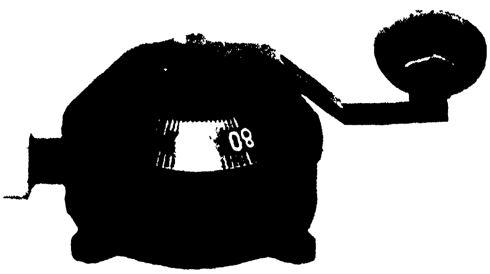
When asked how important he regarded the radio telephone, Allen said, "Instead of flying into the unknown and meeting shifting weather con-



Passengers who board this 18-passenger tri-motored plane, operating on a 20-hour schedule between Chicago and San Francisco, know that their pilot will have continuous radio communication with ground stations ditions single handed and without adequate information, the pilot will be maintaining uninterrupted contact with the broadcast voice of the radio.

"He may, for example, speak into the mouthpiece which unobtrusively rides in front of his lips: 'Calling Cheyenne Boeing Station Number 12 reporting passing Elk Mountain point 106. Fog and snow coming in across course from Medicine Bow range. Fog forming along Union Pacific tracks in Rock River sector. Looks clear to north. Ceiling here 1500 feet, visibility five miles. Snow blowing on ground so badly weather station may say zero ceiling and visibility. What is weather in Laramie? Would you advise crossing Sherman Mountains north of the course and coming into Cheyenne from north?' And instantly comes a detailed answer to all his questions through his ear phones."





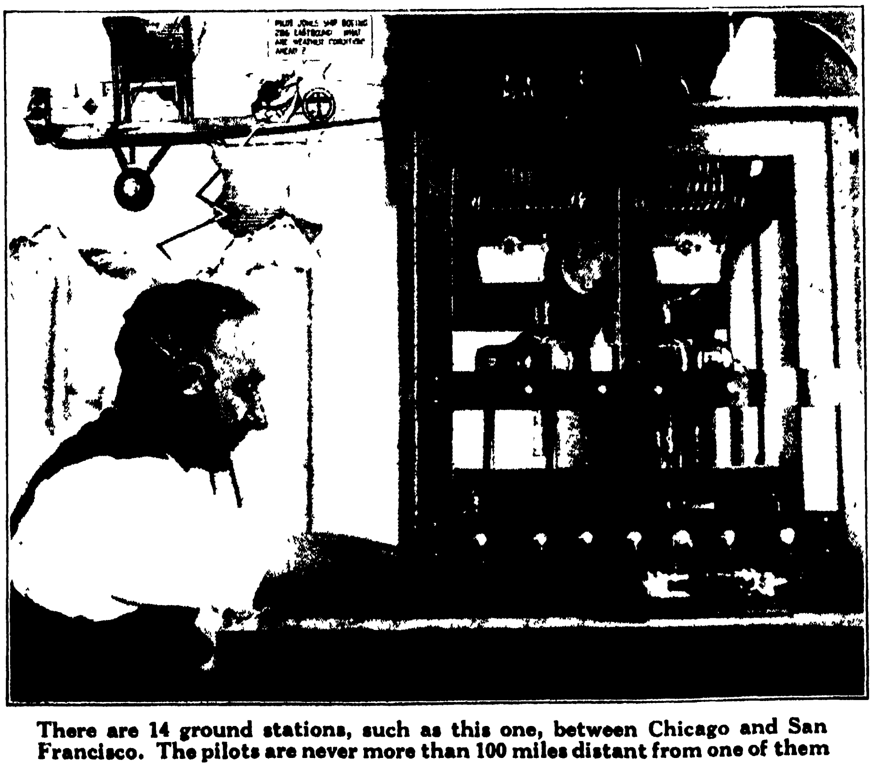
Above: **The radio equipment that is installed on a plane. From left to right is the transmitter, tuning instruments, and receiver.** ***Left:*** **The tuner. The knob can be operated even with heavy gloves on**

ON one of the occasions when Lindbergh jumped from his airmail plane near Chicago after attempting to find the Chicago airport through the clouds, the field crew heard his motor overhead and knew that if they could but talk to the pilot, they could have brought him in as easily as a passenger train is threaded through the switching yards to the terminal station.

For the pilot, the operation and mechanism of the new radiophone are nearly automatic. He speaks in a normal voice and listens to the reply without the intervention of a radio operator aboard to give him the messages second hand. He can easily control the loudness of either the radio beacon signal or the voice reception as he comes nearer the station, or he can listen to both at the same time, making one or the other louder, as he desires. Boeing pilots have received clearly at 200 miles from the control station and 12,000 feet altitude, and even greater range is expected.

Since the equipment requires no careful adjusting on the part of the pilot, his full attention can be directed to the operation of his engine and keeping the airplane on its course. Added weight and space, which would be necessary for a special radio operator on the plane, ruled out any apparatus requiring expert manipulation in flight or the services of a special operator.

In the equipment, radio cases are mounted behind the pilot with remote controls on the instrument board. With a single throw of a switch, the pilot can change from transmission to reception. All that is required then, is for him to talk into the microphone mounted on his helmet directly in front of his lips.



There are 14 ground stations, such as this one, between Chicago and San Francisco. The pilots are never more than 100 miles distant from one of them

TINY, soft rubber plugs, with "phonettes" attached, fit comfortably in his ears and are connected to the receiver with a fine silk cord. Thus, the pilot, if flying through a snowstorm where constant vigilance is required, will have to give no thought to the radio apparatus.

Now the United States can lay claim to the longest line in the world giving night and day passenger service, with planes having voice communication with the ground and with other planes in flight. In Europe, most of the radio sets require an operator using the Morse code. In the setup discussed here, the pilot simply talks to the nearest ground station, of which there are 14 between San Francisco and Chicago and nine between Los Angeles and Seattle. Either night or day, over plain or mountain, the pilots of the eight-ton passenger transports now place reliance on instructions 'phoned up from the ground station by men who, with the aid of reports received from weather observers on and off the line, can tell the pilot what kind of weather he will run into before he gets to the terminal port.

¶ *A coming article will describe how archeologists, under the direction of Mussolini, have found ancient Roman buildings by tearing out the walls of modern structures.*

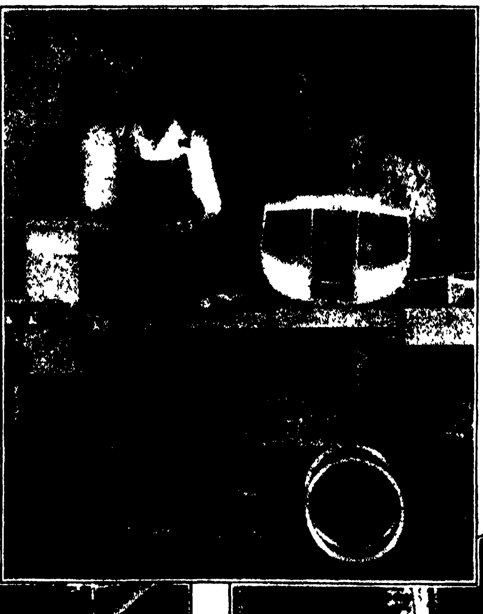
This tableau depicts the famous race between the "Tom Thumb" locomotive and the old gray mare drawing a single coach. The race took place between Baltimore and Ellicott's Mills on August 30, 1830. The rails are made of wood faced with steel. The costumes of the eight men and eight women are accurate to the last button. The horse won owing to "belt failure"

A World in Miniature

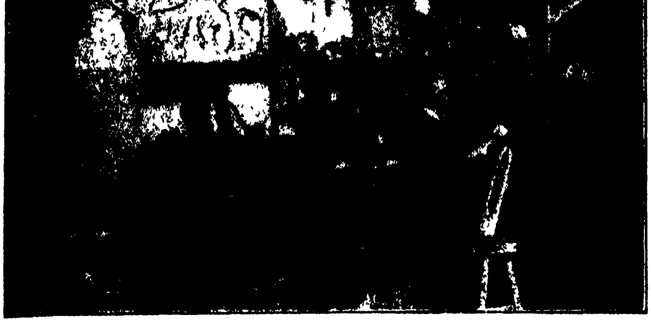
WAY down in "Chelsea Village," New York City, in an old armory is a shop which would be the delight of both the museum director and the child. Here are made camels that almost walk, monkeys that play cards—and cheat, dogs that fight for bologna links, and dolls nine feet tall. Who requires such peculiar merchandise? Department stores, pageants, fairs, children's barber shops, and dozens of others. This shop was an important factor in the "Iron Horse Fair." Here is made anything in papier mache, wood, or metal, which can be endowed with motion. We were recently invited to inspect a series of eleven miniature groups illustrating the history of transportation which were made at an expense of 150,000 dollars. The time required was one year, eight months.

We were particularly struck with the rare fidelity with which detail was handled. Think of trying to get fabrics for diminutive men's clothing and women's dresses of the period of 1830. Ancient "deposits" of textiles were uncovered and utilized. The literature of transportation and every avenue of knowledge was put under contribution, and the result is so worth while that we are presenting a series of illustrations showing how it was done.

The groups are 12 feet long and six feet deep, just right size for a show window. The "ground" is a rubber composition which cannot be damaged by rolling. The whole series of groups can be packed in special water-proof cases. They can all be transported on a trailer 23½ feet long, 7 feet wide by 7 feet high, inside measurements. The groups are intended for exhibition in stores, automobile salerooms, and other places where an educational exhibit is deemed worth while. The groups are so expensive to fabricate that they could hardly be purchased, except by museums. A "Deadwood" coach would cost 5000



Coach makers and boiler makers are plying their respective trades. The coach is a marvel of skill and patience. Every cushion is beautifully fashioned and the springs are accurate reductions. Every rivet in the *DeWitt Clinton* is real

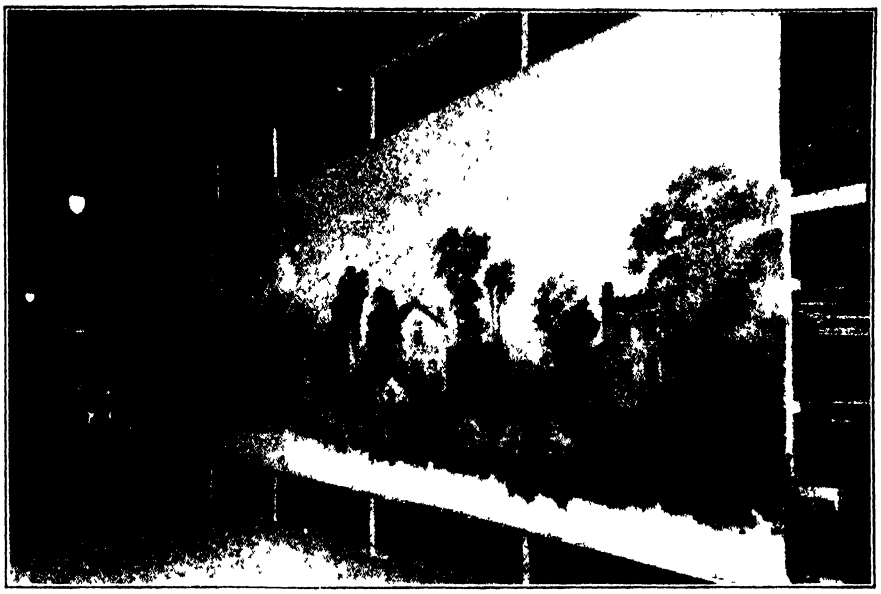


The saddler's trade is a vanishing one. This man makes wonderful saddles, harness, curtains, and cushions

The wheelwrights are on the job making miniature coach and wagon wheels as well as the running gear

dollars and the *DeWitt Clinton* locomotive as much more.

The groups of this particular exhibition are as follows: The Indian Pony Drag, the Conestoga wagon (this great prairie schooner passed its 100th birthday a few weeks ago), Fulton's *Clermont*, the *Tom Thumb* locomotive on the Baltimore and Ohio Railroad, the *DeWitt Clinton* locomotive, the Deadwood Coach, the Pony Express with Buffalo Bill, Lincoln in his carriage, the race betwen the *Natchez* and the *Robert E. Lee*, the Selden automobile, the Wright airplane at Kitty Hawk.



The scenic artist is painting the background for one of the scenes. It is a compromise art between easel picture painting and scene painting. The handling of the various backgrounds helps along the illusion of reality

THE backgrounds were painted by real artists, the designs being made by Mr. Joseph Damon of Messmore and Damon, whose unique shop we are illustrating. Then began the correlation of industries and trades some of which are all but extinct. The coach maker used the care that was expended on a Brewster body. Every bolt and nut and every cushion was reproduced with absolute fidelity. The coppersmith made the boiler for the *DeWitt Clinton*, reproducing every rivet. When the tender was being made, it was found that the floor had been made with the rivets in the frame parallel instead of staggered as they should be. *Crash!* it went into the brass junk barrel and a new one was made with the rivets properly disposed. Probably only two or three persons in the United States, amateur model makers, would have noticed the difference.

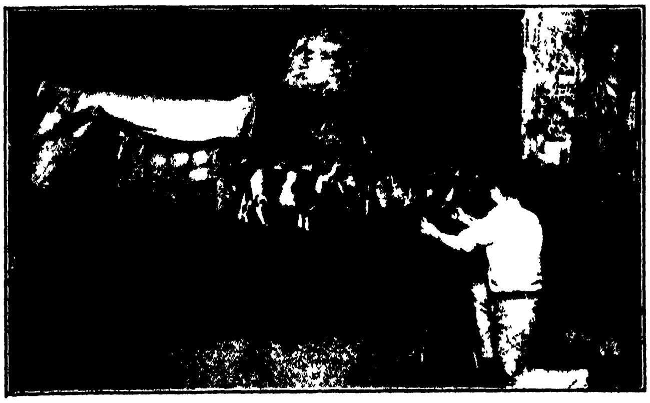
Meantime, the wheelwrights had been making the miniature wheels and the saddler had been spending days on the harness or the hood for Lincoln's state carriage. Not far away, the blacksmith had been making the springs, leaf by leaf, and the woodcarver was making the little wooden figures, for there is no composition or papier mache used here. Meantime, the wigmaker was weaving each hair into a silk foundation and the dressmaker was making poke bonnets, hoop skirts, and men's coats from material from a celebrated Chicago collection.

The woodcarver is also a sculptor. It took him a week to carve the head of Lincoln for the lifelike scene where the martyred President is driving. The woodcarver makes many of the accessories

The shipbuilders have been busy on their steamboats, and the sign painters are getting ready to paint the names on the paddle boxes, with the names of the company on the curve. Even such details as this required considerable search in a library where at last an early lithograph was found which gave the desired facts. Other workmen have been cutting little sticks for the fuel for the *DeWitt Clinton*, and "smoke" for the racing steamboat is supplied by mineral wool. The horses shy at the new fangled Selden automobile and it is no wonder, for it is a fearful and wonderful contraption. Nearby, the Wright Brothers are getting ready to fly 852 feet in 59 seconds. Twenty-six and one-third years later, Mr. and Mrs. Lindbergh crossed the continent, making the trip of 2100 miles in 13¾ hours at altitudes of 14,000 to 15,500 feet.

"The Story of Transportation in America," is what the show is called.

The *Clermont* will soon take the water. The model is really a monument to patience. Even the smallest detail is worked out with the greatest possible care



The Conestoga wagon was destined to carry pioneers across the continent. Its centenary has just been celebrated. Here we have the last finishing touches

The Physical Nature of Death*

By George W. Crile, M. D.,
Marie Telkes, Ph.D.,
AND
Amy F. Rowland., M. A.†

THE terms "living" and "non-living" and "dead" denote variations in energy and form. In structure the living organism is identical with the non-living—just as the live battery is identical in structure with the dead battery. But what is the essential feature in the living organism upon which structure depends? What is lost in death?

Thirty-five years ago I first attempted to approach this problem by an investigation of the basis of death. Phenomenon after phenomenon associated with death was critically examined and set aside as it was found to be a result rather than a final cause of death.

Studies of the circulation and respiration showed that the changes in these vital phenomena which are present in exhaustion and death are end effects and not primary causes of death. So, too, studies of the chemistry of the blood, while they revealed that the acid-alkali balance of the organism is of vital significance, did not reveal the cause of death.

RESUSCITATION experiments were performed in which it was found that in normal animals after complete cessation of the circulation for from five to seven and a half minutes, resuscitation followed the infusion of adrenalin into an artery; in the course of these experiments the sequence in the return of the various functions and reflexes was observed. But these experiments, important as they were, did not reveal the cause of the cessation of circulation and of the final death which would have followed had not the dose of adrenalin been administered.

By the examination of great numbers of cells under the microscope we found that certain histologic changes were invariably present in the cells of the brain and of the liver after death from any but sudden and accidental causes. The nuclear-cytoplasmic relation was disturbed and the semipermeable membranes were in process of disintegration. That life was incompatible with such a condition of the cells was obvious but was the condition of the cells in itself the actual immediate cause of death?

Later we directed our investigation to the determination of certain physical constants in various vital and lethal conditions. We found that the processes leading to death were always accompanied by a decrease in the conductivity of the brain and of other components of the central nervous system, and by an increase in the conductivity of the liver with corresponding changes in the electric capacity of the cells. But certainly a change in the conductivity and capacity could not be the immediate cause of death.

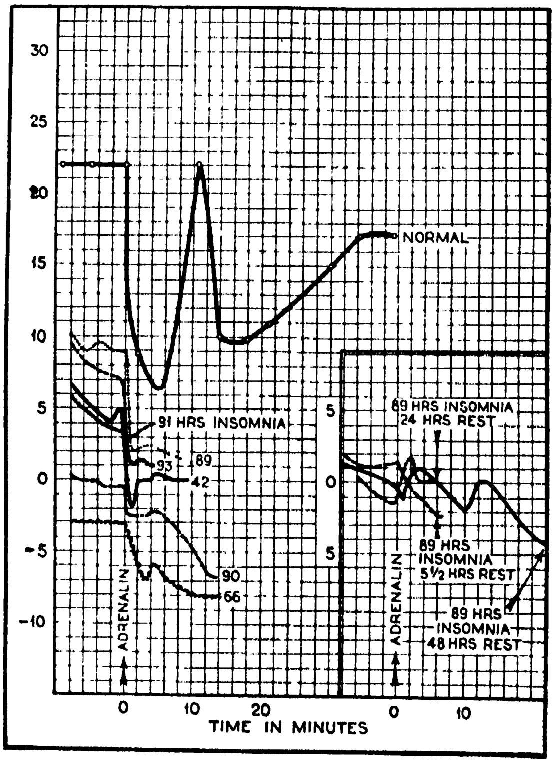


Figure 1: **Effect of insomnia on the potential of brains of rabbits. Note diminished response to adrenalin in the insomnia rabbits**

Death may result from many diverse causes: from hemorrhage, from physical injury, from infection, from insomnia, from anesthesia, from asphyxia, from surgical shock, from the excision of certain organs—any of these agents alone may produce death, or death may be due to a combination of any of these different factors. Thus in war a soldier may die not as the result of wound alone, or infection alone, or insomnia alone, or anesthesia alone but as the result of a combination of all these various factors. But whatever the cause of death the phenomena of death are identical.

In death the energy characteristic of life is lost—the dead body is in equilibrium. In death the living structures, namely, the cells, are unable to hold their form and structure and inevitably disintegrate. In death the delicate organic molecules such as the fatty-acid chains lose an organizing, binding influence and they too disintegrate.

WE propose now to offer new experimental evidence which identifies a form of energy that is lost in death—a form that is capable of constructing the films and of holding together the essential organic molecules.

These researches which have been carried out in the research laboratories of the Cleveland Clinic Foundation were directed toward finding the relation between electrical potential and oxidation; that is, toward determining whether one or the other is the primary factor in the maintenance of life and whether the loss of one or the other is the essential factor in the production of death or whether both together are primarily essential. Our researches were especially directed toward the discovery of the influence of potential on oxidation; the influence of potential

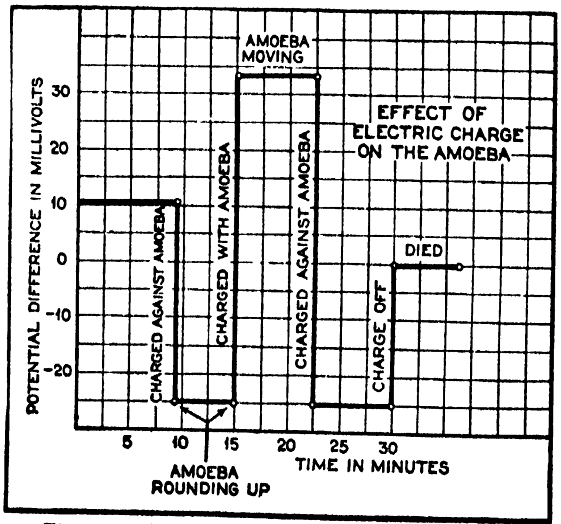


Figure 2: **Effect on the potential of an amoeba of direct and of counter electric charges**

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*A paper presented before the American Philosophical Society and reprinted by permission, from the *Proceedings* of that society, which was founded 1727 by Benjamin Franklin

†See "Among our Contributors," page 5.

on the form of the living, and by inference on the maintenance of the organic molecules; and to the discovery of the relation of the potential to death.

The results of these researches may be summarized as follows:

1. In animals, plants, and fruits an electric potential exists during life and disappears at death.

2. The potential is varied by insomnia, by anesthetics, by poisons, by hemorrhage, by asphyxia, by change in electrolytic solution, by adrenalin, by injury, by heat, and by cold.

3. At the moment of clinical death the potential difference between different organs drops to zero for a few moments; following this, each organ regains its potential for a short time, but finally the potential of all tissues drops to zero, the respiration of the tissues stops, and molecular disintegration sets in.

ARE we then correct in ascribing the cause of clinical death to the fall in the potential between the different tissues, and the cause of the death of single cells or of tissue cultures to the fall in the potential on the cell membrane?

Of primary importance was our finding that insomnia by itself alone produces a progressive loss of potential. In our experiments, if insomnia was sufficiently protracted, the potential declined to zero and the animal died. As the potential approached zero, recovery of potential followed a sufficiently prolonged period of sleep and of rest. Of special significance was the fact that after prolonged insomnia the animal did not respond in normal fashion to the injection of adrenalin. (Figure 1.)

If the molecular structure depends upon an electric strain or potential which also enables the organism to function and grow, we must find direct evidence therefor. Happily we found such direct evidence in observations of the potential of an amoeba. Dr. Telkes designed and constructed an electrode which could be inserted into an amoeba and with this electrode she made measurements of its potential. She found that the potential of the amoeba ranges as high as 15 millivolts and that it changes with alterations in the concentration of the electrolytic solution in which it is immersed, with changes in temperature, and when anesthetics are added to the suspending solution. Radiation, adrenalin, and sodium iodid all induce characteristic changes comparable to those seen in rabbits and in dogs.

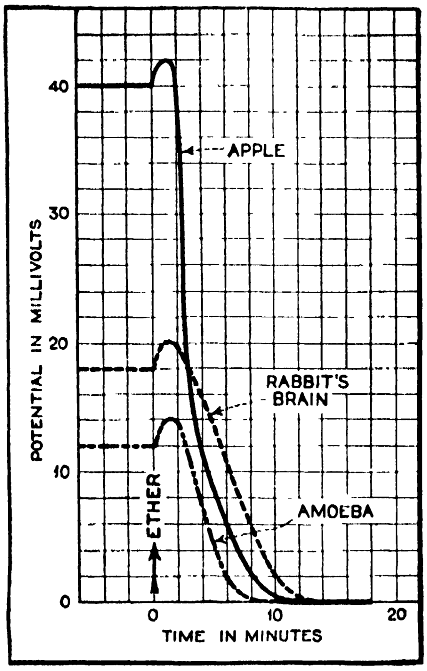


Figure 4: **Effect of ether on potential of apple, brain of rabbit, and an amoeba again, same effect**

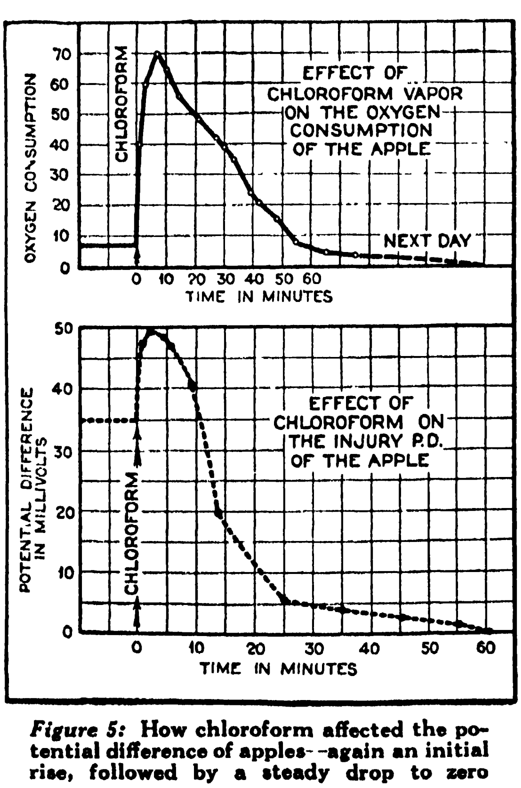


Figure 5: **How chloroform affected the potential difference of apples--again an initial rise, followed by a steady drop to zero**

The amoeba was observed under the microscope during the experiments. Here we had our first opportunity of noting under the eye the changes in structure which are produced by these various agents. Of special interest and importance were the effects of changes in potential produced by the direct application of an electric charge which could be varied at will. When the charge was increased the potential rose, and the amoeba became more active. On the other hand when the potential was diminished by introducing a current the direction of which was opposed to that in the amoeba, the amoeba progressively became less active and withdrew its pseudopodia; that is, it rounded up into a quiescent lump, until when the potential reached zero or went over to the negative side the amoeba disintegrated first into larger then into smaller granules and fragments and finally disappeared in the suspending solution. When, however, the potential was lowered by the counter-charge, and by no other factor, nearly to zero and was held there, the amoeba would round up and some granules might even disintegrate; but if at that crucial point when death and disintegration were imminent, the potential was raised by increasing the charge and by nothing else, the amoeba would pass from the resting to the active state, and would again throw out its pseudopodia. (Figure 2.)

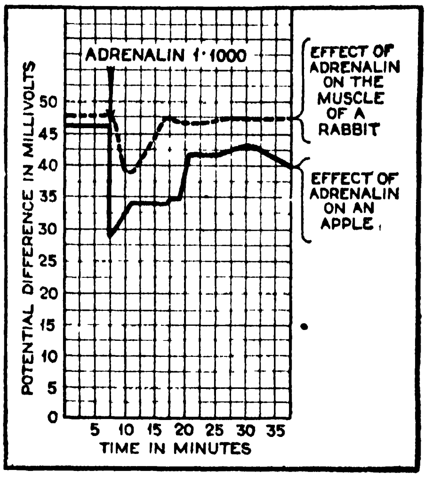


Figure 3: **Effect of adrenalin on the potential of muscle of rabbit (animal) and on potential of an apple (fruit); that is, effect was same**

This crucial experiment indicates that the fundamental control of the molecular integrity and of the activity of the amoeba this difference between life and activity and death and dissolution --is governed by the change in the electric potential. In our experiments activity, quiescence, death, and dissolution were governed completely by the production of variations in the potential alone.

FROM this we may infer that the organic molecules that are bound together in the animal organism, the arrangement of crystalloids and colloids, the separation of nucleus and cytoplasm, the maintenance of the molecular organization—we may infer that all these phenomena are manifestations of electric force. Electrical potential is the product of chemical activity and in turn the electrical potential governs chemical activity. These electrical and chemical processes are the governing factors in the production of the phenomena which are characteristic of life. In their absence the organism is dead.

If the organic compounds, structures, and so on, in plants and in animals are created by electric potential and chemical activity, especially by

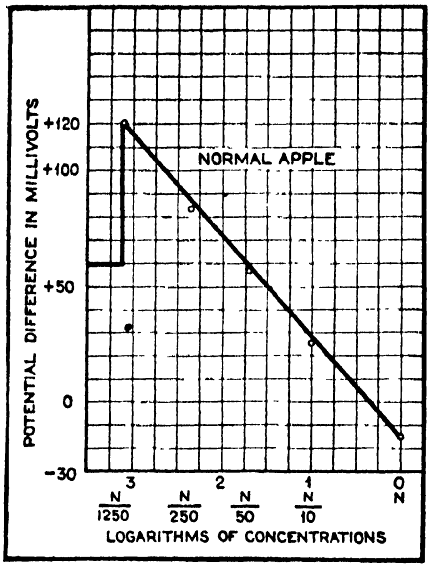


Figure 6: **Logarithmic curve showing effect of varying concentrations of sodium chloride on the potential of a normal apple. The circles represent the five observed values**

oxidation, then in such intermediate forms of life as fruit the same law should hold.

We therefore extended our researches to an investigation of the phenomena of potential and of oxidation in fruit and we found that every kind of fruit has a potential—the potential of an apple, for example, is about 50 millivolts, and the apple has also a steady respiration—consuming from three to four cubic centimeters of oxygen every hour.

In our experiments we found that the potential and the respiration of the apple change in the same direction under the influence of anesthetics, and of changes in electrolytic concentration. The administration of adrenalin, changes in temperature, and the exclusion of oxygen affected the apple just as they affect the rabbit and the dog. (Figure 3.) Anesthetics caused first an "excitant" stage which was indicated by a rise in potential and an increased metabolism; that was followed by a continuous fall of both the potential and the metabolism to the zero point, after which neither potential nor metabolism was again manifested. (Figures 4 and 5.) Adrenalin caused a fall in potential followed by a rise and the respiration of the apple was increased. Changes in electrolytic solutions caused changes in potential which were in conformity with the Nernst formula. (Figure 6.) When the electrolytic concentration equaled the concentration of the electrolytes in the apple the potential fell to zero. Immersing the apple in oil caused the potential and respiration to fall to zero and to remain there. Increasing the temperature of the apple caused the potential and respiration to rise together and after an irregular fluctuation at a given height both fell to zero and remained there.

In all cases in which the potential was reduced to zero the apple disintegrated, just as animals and plants and the amoeba disintegrate when their potential is reduced to zero. A battery was constructed by arranging halves of apples in series and a potential of over a volt was thus created. (Figure 7.)

By this study we have demonstrated that the structure of the apple, like that of the amoeba, is dependent on potential and here again we saw the relation between electric strain and the maintenance of the organic structure.

If oxidation is due to a difference of potential and if living cells are concentration cells, then if apple juice were placed on one side of a celluloid film and distilled water on the other, oxidation and potential should be manifested just as in the apple, amoeba, or rabbit. Such an arrangement was made and as a control another artificial "concentration cell" was set up which was identical with the first, except that a hole was punched in the celluloid film in the control cell. Observations of metabolism and of potential showed that the first artificial cell functioned like the apple and the amoeba; that is, it had a potential and it showed respiration; the control cell, on the other hand, had neither oxidation nor potential.

IN brief, then, in a large series of experiments we have found that in animals and in plants and in fruits there exists a potential which has a certain range during life and disappears at death. This potential is dependent on the presence of a semipermeable film, on certain electrolytic concentrations, on water, on temperature, on oxidation, all of which together create the organizing potential. It is the charge on the films of the cells which endows the organism with its selective or adaptive property; oxidation occurs only in the presence of an electric charge and the charge is created by oxidation. Life is a phase of the organization created by electric strain or potential and death is an inert stage in which potential is lost and disintegration is inaugurated.

Or we may define life and death in the following terms: Life may be defined as a potential which is maintained and is varied adaptively according to environmental conditions, this potential being maintained by chemical activity—mainly by oxidation. The loss of this potential is death. The principal difference, then, between that potential which is life and the potential which is present in non-living systems like concentration cells is that the living potential is spontaneously and adaptively alterable.

In brief, then, life in the unicellular organism is an adaptively changing difference in potential between the cytoplasm and the medium in which it exists, and presumably between the cytoplasm and the nucleus. In the lowest forms of multi-cellular organisms life is an adaptive difference in potential between the central nervous system and the rest of the organism; in the higher multicellular organisms life is an adaptive difference in potential between the brain and the other organs and tissues, especially the liver. The life of an organ or tissue depends upon the maintenance of a difference of potential between the cells and the intercellular medium, and presumably between the nucleus and the cytoplasm of the individual cells of which it is composed. And in the unicellular and in multicellular organisms alike death is the absence of a difference of potential—final equilibrium.

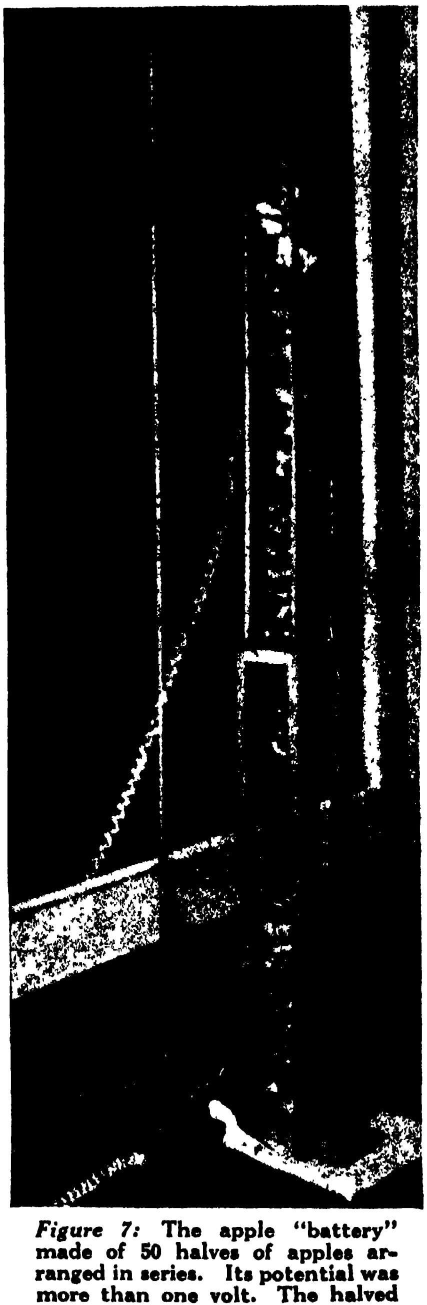
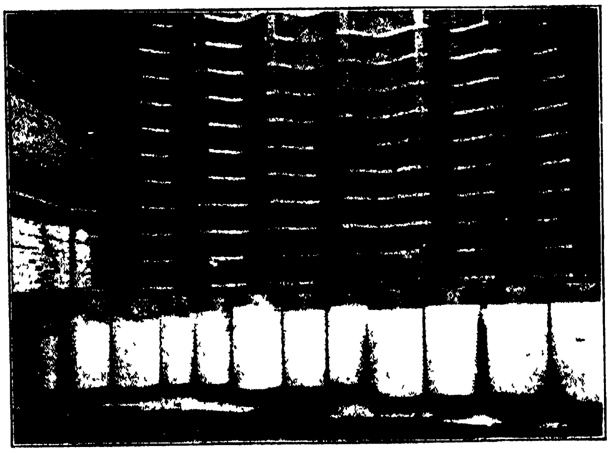


Figure 7: **The apple "battery" made of 50 halves of apples arranged in series. Its potential was more than one volt. The halved apples are piled up in series and electrodes are attached to the bottom and top halves respectively**

Shipping Newsprint Paper in Safety

A CURIOUS craft, the S.S. *Markland*, has been recently making trips from Liverpool, Nova Scotia, to New York at frequent intervals. She was built to perform one duty; namely, to transport 8000 rolls of newsprint paper without chafing or wetting. Of course, paper has been carried by ships from time immemorial but not in this manner. The vessel, which is 336 feet long and of 4454 gross tons, is built on the deep-frame principle. Her cargo holds are constructed with as boxlike formation as possible. All brackets, stanchions, pillars, et cetera, have been omitted and otherwise compensated for. Frames in the cargo holds are continued through the main stringer to the height of the bulwark, with the inner flange of channel removed and watertight collars fitted. The frames are bracketed to the deck. This method of construction compensates for the absence of the ordinary beam brackets usually associated with deep-frame construction, the brackets being eliminated from the hold to obtain better stowage. Frames in cargo holds have steel cargo battens covered with wood to prevent any damage to the newsprint from coming in contact with bare metal. The vertical bulkhead stiffeners support steel strips, wood covered. These strips are so curved as to allow paper rolls to be stowed snugly and firmly between the stiffeners, while the holds forward and aft are boxed vertically in the way of curvatures to allow rolls to be stowed tightly in a vertical position. Wooden battens protect the newsprint from contact with the metal.

The rolls are transferred to trucks by electric tiercing machines



The rolls fit closely. When each tier is complete, painted boards are placed over the top, making a floor for the next tier of rolls of paper

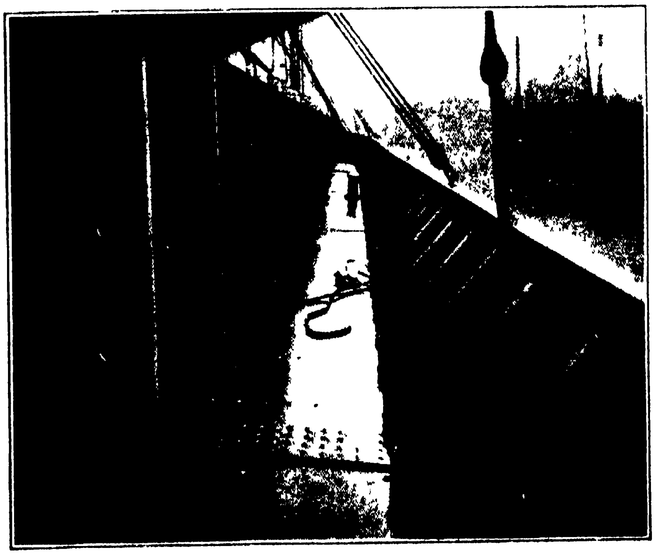
The keel is on the duct principle forward of the machinery space to the fore peak bulkhead to allow steam lines for winches, water pipes, et cetera, to be carried forward clear of cargo holds. The *Markland* was built at Hull, England from the design of Mr. Walter Lambert of Montreal.

The five holds each take care of four or five tiers of paper rolls with painted wooden boards, or "dunnage" separating each tier. Every precaution is taken to avoid danger by water as well as chafing. All pipes are enclosed in other pipes to prevent dripping.

THE regular trip of the *Markland* occupies about 44 hours. Once the pier in New York is reached unloading begins at the rate of 200 tons an hour. The rolls are turned down horizontally and two are swung up through the hatch at one time, the ends of a bridle being inserted in the iron cores. Although hoisted collectively, once on the dock they are handled individually by tiercing machines or trucks which grip one roll at a time, elevating it and carrying it to the waiting truck which when fully loaded, rushes off to carry the paper to the waiting presses.

The pulp wood all comes from Nova Scotia, where the paper is made by the Mersey Paper Company of Liverpool, Nova Scotia. In this plant two paper machines each produce a ribbon of paper 222 inches wide at a speed of 1000 feet a minute.

Steel cargo battens close the five hatches; ten steam winches discharge the paper at a rate of 200 tons an hour



All stanchions, pillars, et cetera, are omitted and they are compensated for by a deep-frame construction

The Mystery of Gypsum Cave

By M. R. Harrington*

Curator, The Southwest Museum
Member, American Anthropological Association

Discoveries Near Boulder Dam Point Either to High Antiquity for Man in America, or to a Later Survival of Certain Extinct Animals Than Heretofore Has Been Believed

IN a deep, dry cavern in the mountain ranges east of Las Vegas, Nevada, overlooking a wide stretch of desert and the distant rugged gorge of Black Canyon—future site of Boulder Dam- an even dozen men and women are trying to unravel a fascinating mystery. This mystery concerns not only America's first human inhabitants, but the strange beasts of a by-gone age.

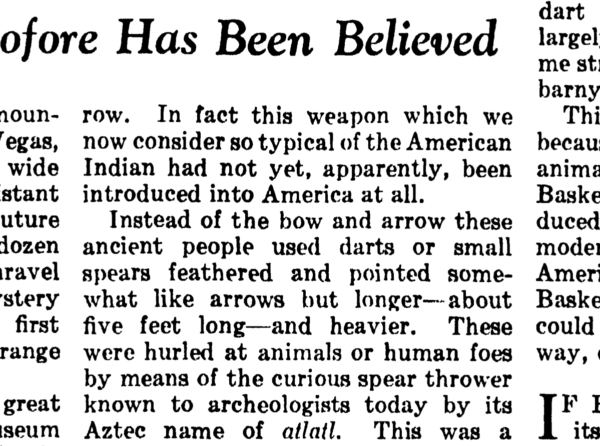
The workers represent two great institutions, the Southwest Museum of Los Angeles, and the California Institute of Technology working in co-operation, a rare example in this country of archeologists and paleontologists laboring side by side on the solution of a single problem.

I am no stranger to the exploration of caverns, but the first thing I sensed when I first entered Gypsum Cave in 1924 was the mystery of the place. Here was something different, a situation I had never found before.

A little digging near the entrance showed traces of early Pueblo Indians like those who occupied Lost City and Mesa House in the nearby Moapa Valley (both of which have been described in the pages of the SCIENTIFIC AMERICAN[1]) and even of the more recent Piutes. In the rear chambers, however—and the cavern was 300 feet long and 140 feet wide—the only human relics I could find belonged to a much more ancient people, the Basketmakers, who in fact are the oldest inhabitants of our southwest known to archeologists. Reliable authorities even estimate their date as about 1500 B.C.

The Basketmakers are remarkable for the fact that, although they had made a beginning in agriculture, they were ignorant of pottery and knew nothing whatever of the bow and arrow. In fact this weapon which we now consider so typical of the American Indian had not yet, apparently, been introduced into America at all.

Instead of the bow and arrow these ancient people used darts or small spears feathered and pointed somewhat like arrows but longer—about five feet long—and heavier. These were hurled at animals or human foes by means of the curious spear thrower known to archeologists today by its Aztec name of *atlatl*. This was a carved throwing stick about 20 inches long, with a hand hold on one end and a small hook on the other, which engaged a socket or pit drilled into the butt end of each dart. The throwing-stick or *atlatl* in effect added its 20 inches to the length of the user's arm and gave him that much more advantage in velocity when he threw his darts.



In the Pleistocene Epoch ground sloths, some as large as elephants, ranged from California and Pennsylvania to Patagonia. This one is *Nothrotherium*

One of the methods by which archeologists distinguish *atlatl* darts from large arrows is by the fact that the butts of the darts are always provided with these sockets instead of with the notches for the bow-string seen on arrows. I am describing these things here because the Basketmaker relics I found that day in the inner chambers were mainly fragments of such darts.

Now these Basketmaker remains lay on the *surface*. What might lie in the deposits below the surface was an intriguing mystery.

A few test holes revealed the fact that the deposits, upon which the dart fragments lay, consisted very largely of compact manure, reminding me strongly of some old horse corral or barnyard.

This only deepened the mystery, because I could not understand what animal might have existed before the Basketmakers that could have produced such a deposit. I knew that modern horses were introduced into America by the Spaniards, long after Basketmaker days; and that no horses could have penetrated the cave, anyway, on account of its small entrance.

IF Basketmaker dart shafts lay on its surface, the manure must certainly be older than the Basketmakers; that is to say, probably more than 3500 years old. I resolved to return some time and solve the problem, if it was solvable.

However, the Museum of the American Indian, Heye Foundation, with which I was connected at that time, abandoned its Nevada work and I was unable even to visit the cave again until January 1929, when I returned to the region in charge of an expedition from the Southwest Museum of Los Angeles, to work once more in the Moapa Valley.

During the same spring I made several visits to the cave, one of them with Mr. Jesse L. Nusbaum, archeologist for the Department of the Interior, and we both agreed that the manure deposits might well have been left by some animal now extinct, maybe some species of ground sloth, and that the cave should be explored at the first possible moment.

This opinion was strengthened after the close of the expedition when Professor Barnum Brown, of the American Museum of Natural History, examined specimens of the dung. He thought there could be little doubt that some kind of ground sloth was responsible for it, basing his deductions, I believe, on a previous find in South America.

And when the long-hoped-for chance came in January, 1930, to lead out an expedition for the express purpose of solving the mystery of Gypsum Cave, I was overjoyed. However, I fondly imagined that a few weeks would bring the answer. . . . At this writing 11 weeks have passed, and while we have learned much, the mystery is still a long way from full solution.

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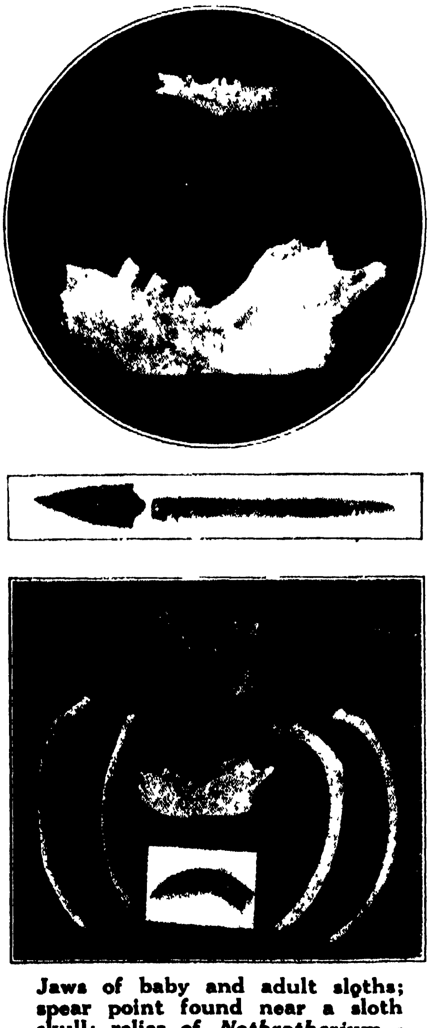
*See "Among Our Contributors," page 5.

[1] "The Lost City of Nevada," M R Harrington, July, 1925, pages 14-16, "The Last Stand of the Nevada Pueblos," Irwin Hayden, February, 1930, pages 132-135

Our first task was to examine the surface of the cave floor and all its crannies and crevices as carefully as we could. This resulted in finding, scattered everywhere in the inner rooms of the cavern, hundreds of fragments of wooden and cane dart shafts broken and splintered. Most of them, as were the first ones found in 1924, seemed to be the work of the Basketmakers. There were also countless burnt sticks—the remains of torches.

TWO ancient wooden flutes, some curious bits of archaic basketry, and occasional other relics turned up, including even a few fragments of more modern arrows, but these were as nothing compared to the hundreds of splintered primeval weapons which littered the place. Why were there so many, and why so splintered? The mystery deepened.

Then we found upon the surface among the dart fragments some strange-looking bones, and then my niece, Bertha Parker Pallan, found the unmistakable skull of a ground sloth! We learned later that it belonged to the ungainly species known as *Nothrotherium,* not the largest of the ground sloths by any means, but a creature about the size of a husky brown bear. The skull was not buried; it lay upon the surface protected from view only by an uptilted slab of rock.



Jaws of baby and adult sloths; spear point found near a sloth skull; relics of *Nothrotherium*—hair, ribs, jawbone, and a claw

Right to left: **Dr. E. L. Furlong and Dr. Chester Stock of California Institute of Technology; Dr. Scherer, Director of Southwest Museum; the author**

Was this really a clue? Our suspicions as to the origin of the manure deposits were strengthened, of course, for we now knew with certainty that the cave had been a sloth den, but what of the darts? Had they been thrown to slay the odd, misshapen beasts of the cave?

Only digging could reveal the answer, and dig we did, starting a trench in the main chamber. Here we found bones—a few of them—some of the mountain sheep, some of a small variety of horse, even a piece of a sloth claw, but nothing made by man.

It seemed a cruel fate that it was not the hard-working trench diggers who made the next big find, but an outsider, or almost an outsider. It was Mrs. Myrtle Evans, wife of one of our Indian helpers, and herself an Indian of the Washoe tribe, who was visiting the cave one afternoon with her little nephew. Scratching with a trowel in a distant end of the cavern she unexpectedly turned out a big bone. It was a sloth vertebra! Soon we had uncovered a large part of the skeleton of a *Nothrotherium,* so well preserved in parts that one great claw still retained it horny covering. Bunches of the long, coarse, tawny hair, with its dark shading, were in perfectly good condition.

In rock crevices near the bones appeared a bit of native string made of yucca fiber and some small feathers wrapped with sinew, possibly part of the decoration of a head dress or perhaps part of a votive prayer stick.

The situation seemed too much for a mere archeologist to handle and I wired for help—paleontological help. In answer, our Museum's director, Dr. James A. B Scherer, brought to our camp Dr. Chester Stock of the California Institute of Technology, a leading authority on ground sloths, and his associate, Dr. E. L. Furlong. As a result of their visit this institution joined us, and now a joint expedition is laboring in Gypsum Cave. A paleontologist, Mr. J. F. Thurston, is continually on the ground and frequent visits are made by the others.

We have a capable and interested force, including Mr. Charles Amsden of the Southwest Museum, and Mr. Willis Evans, my Pit River Indian friend who worked with me at the Lost City and Lovelock Cave and is now foreman of our laboring crew.

GYPSUM CAVE (named, by the way, for its beautiful crystals of gypsum or selenite) is not easy to explore. This is not only because practically every chamber is cluttered with rock falls, large and small, but principally because the lowest level is 64 feet below the entrance, and the passage from the entrance to the inner chambers is so steep and in places so narrow and tortuous that to carry our tailings or "back dirt" completely out of the cave, as we desire to do, would require a mechanical hoist such as is used in mines, and a lot of blasting. To build such a hoist would require so much outlay of time and money that it would not be justified at present. In consequence, our Zuni Indian workmen are obliged to build huge bins with stone retaining walls, in which to pile the earth and rocks dug from the trenches. Some of these bins will doubtless have to be moved and their contents rehandled when we get ready to explore the cave floor beneath them.

As in a mine, we have found it necessary to timber the roof where it seemed crumbly and in danger of falling; to build cribbing for holding back rockslides that threatened to slip down and engulf us; and even to timber like a mine shaft any pit that must be driven down into the ground to a depth of more than six or eight feet. All of these operations were new to me, after all my 30 years of archeological delving.

Some days are better than others, but almost every day is adding its bit to our knowledge of the men and the animals of the cave.

On the archeological side we are forming a picture of a people who seem to have visited the cave, long before the Basketmakers, but the portrait so far is little more than an impression. At least we know that the Basketmakers were not the first humans; for, far below the level containing their relics, we have found pieces of dart shafts differing from theirs and cruder. However, these shafts are painted with quite elaborate patterns in red and black, blue and green. We think that the points used on this type of dart were lozenge-shaped rather than notched like the Basketmakers', and were fastened in place with pitch. From the tiny drilled pit on the butt of the dart we surmise that the missile was hurled like those of the Basketmakers, with an *atlatl* or throwing stick, the pin of which fitted into the pit of the dart. We also know that the mysterious "first comers" made these darts of arrow brush stalks and feathered them with whole feathers, instead of the split feathers used by the Basketmakers. From the painted patterns we have some idea of their decorative art, but so far these facts are all we know about them.

Above: **Mouth of shaft, 12 feet deep. At bottom were found bones of extinct American horses and camels. Near the surface to the right lay most of the ground sloth's skeleton. *Right:* Here were found sloth bones and various evidences suggesting that man and sloth existed at the same time**

If the Basketmaker was not the first human being to leave a record of his presence in the cave, neither was the sloth the first animal. Deep down in the bedded rockfalls and silt of the cave floor, at least ten feet below the level which has yielded most of the traces of the sloth, we have found bones of American horses and camels. In the upper layers other sloth bones have appeared; also more well preserved claws and hair—even the remains of a tiny baby sloth, not much larger than a cat.

But, as for the mystery, which after all may be boiled down to the question, "Did man visit the cave while it was still a den of sloths?" we have no absolutely positive answer as yet. Little by little, however, evidence is accumulating that may some day, we hope, clear away the shadows. For example in Room 1, which is near the entrance and seems to be the only chamber in which the ancients really made their home, we have found a layer, buried under more than eight feet of other deposits, containing large pieces of sloth dung, scattered specks of charcoal telling of ancient fires, and an occasional object made by man. Another bit of evidence is the discovery of some painted *atlatl* darts at depths ranging from eight to 10 feet *beneath* a layer which has yielded dung and hair of the sloth. Still another is the discovery of the lozenge-shaped dart points under the base of the rockslide upon the surface of which lay the sloth skull, only a few feet distant; while in the back chambers in the layers of sloth manure a piece of polished *atlatl* dart imbedded in the manure itself, an occasional burnt stick in the manure and sometimes even below it, are certainly interesting in the same connection.

Any one of these bits of evidence might be explained away. One can say that the ancients might have carried the pieces of manure up from the depths of the cave to Room 1 to use as fuel, or that the deposit with the hair and dung covering the painted darts was really older than they, but had slipped down upon them from some point higher up the slope of the cave floor. Or one might say that the skull of the sloth had rolled out of some other hiding place after the lozenge-shaped dart points had been buried. One might even say that the dart shaft found in the manure had worked its way in through some hole which was afterwards closed again with manure, and that the burned sticks, in spite of their resemblance to the torch sticks found all over the cave, were the result of spontaneous combustion in the manure, some of which is really burned in patches.

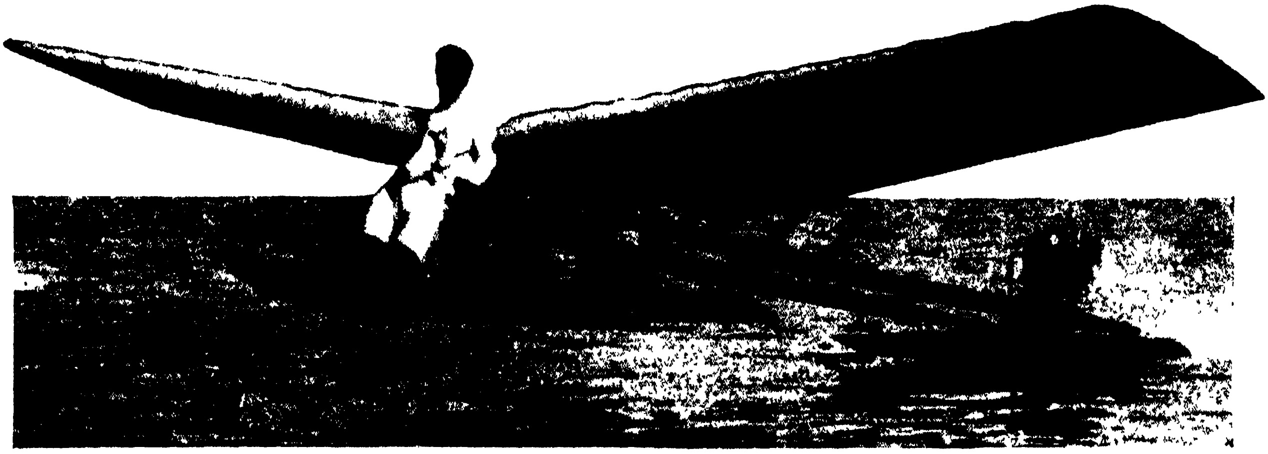
BUT so many bits of evidence in so many parts of the cave are rather hard to explain away *in toto*, and it now looks as if, when the mystery is finally cleared, we may find that the sloth, grotesque survivor of an age of monsters, was really seen in the cave by human eyes, and even possibly that the last of his race were slaughtered for food by some of the first "discoverers of America."

But even if the original mystery is cleared up finally and to the satisfaction of all, there will remain, I fear, still another one which is the outgrowth of the first.

If we prove that man and the ground sloths really existed in America at the same time, does that mean that man lived here twenty thousand or thirty thousand years ago— which is the age usually given to the strange society of animals to which the sloth belonged, the mammoth, the dire wolf, the giant lion, and the saber-toothed tiger of Pleistocene days—or does it mean that some of these animals lived on after the glaciers had receded, until comparatively recent times, say up to within ten thousand or fifteen thousand years of our times? The future alone can supply the answer, if any.

¶ *While this article was in press Dr. Frank Leverett, the widely known glaciologist, described before the National Academy of Sciences the discovery in Equador of human remains, associated with those of a mastodon. This supplies another bit of evidence on the question stated in the above paragraph.*

—The Editor.



The fuselage of the "Waterplane" rises from the water after a run of 150 feet

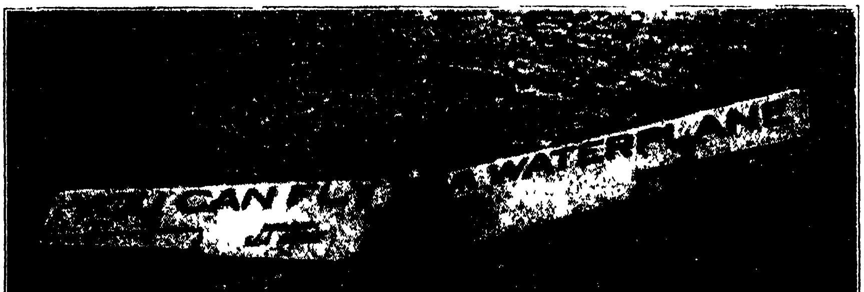
A "Flying" Outboard Motor Boat

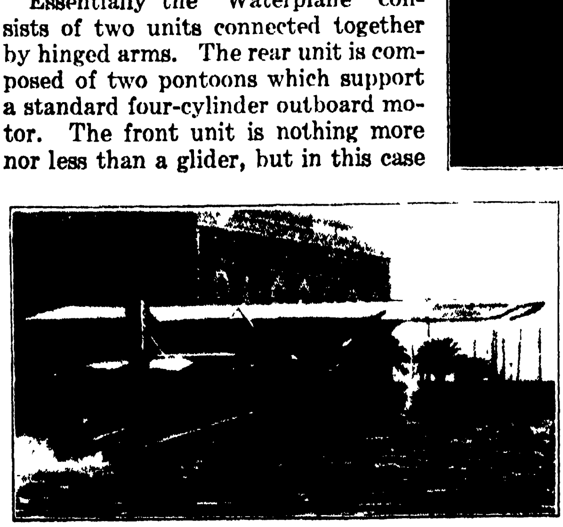
The pilot's right hand is grasping the joy stick, his left the gas control; his feet are on the rudder bar

A NEW water sport that combines the safety of outboard motor boating and the thrills of flying is made possible by the "Waterplane," designed by Russell and Milton Robertson of Alameda, California, after they had repeatedly watched tiny outboard powered racing craft rear their bows out of water. The thought occurred to them: Why not put wings on the boat and lift it completely out of the water?

Essentially the "Waterplane" consists of two units connected together by hinged arms. The rear unit is composed of two pontoons which support a standard four-cylinder outboard motor. The front unit is nothing more nor less than a glider, but in this case it is a glider that does not require a ground crew, being entirely controlled by the pilot. The fuselage of the glider is so constructed that it will float on the water, and can be pushed by the outboard motor. When the proper speed is reached, the pilot manipulates the controls and up in the air goes the glider. The motor stays in the water and continues to furnish the motive power as long as the pilot desires to stay aloft. The glider can reach a height of from 10 to 15 feet above the surface of the water.

Milton Robertson tells of flying a "Waterplane" as follows: "Seated at the controls, the pilot starts the motor by means of the electric self-starter. From a standing start to full flying speed requires a 150-foot run. At first it is best to plane over the surface, getting used to the controls. At about 35 miles per hour, the stick is pulled gently back and the 'Waterplane' leaves the water. At first it took all my attention to navigate but after the first few times aloft, the movements of the stick became automatic. Slowing the motor to a little below flying speed allows the plane to settle gently to the surface."





Above: **A rear view of an open model "Waterplane" about to take off**

At left: **All the thrills of flying in a "Waterplane" built with an enclosed pilot's cockpit**

The glider unit of the "Waterplane" is equipped with the usual controls for ailerons, rudder, and elevators. By proper manipulation of them the pilot can bank on the turns, swoop gracefully from higher to lower altitudes, and get a taste of all of the thrills of actual flight, at the same time literally "keeping one foot on the ground."

Waves and Particles*

By Professor George P. Thomson†

Professor of Natural Philosophy in the University of Aberdeen, Scotland
Non-resident Lecturer at Cornell University

The New Concept of the Nature of Matter

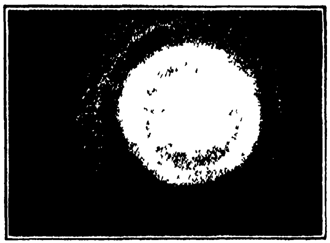
IF I break a piece of chalk, then take each of the bits and break them, and so on, is there any theoretical limit to the progress other than that imposed by the coarseness of mechanical appliances? This is a question which has occupied science since the twilight of its earliest dawn.

In the last three or four years opinions have altered as to the best answer to this question. During the first quarter of this century the answer to the question was quite definite. If the piece of chalk is continually broken and rebroken a time comes when the pieces are no longer merely smaller but become different in kind. This stage can not be reached by mechanical breaking, but it can be reached by heat and suitable chemical action. The chalk has been broken into its atoms. In chalk there are three kinds; other substances would yield other kinds, and, in all, chemists have distinguished 90 kinds from which all matter is made.

THESE atoms are small. They bear about the same relation to a drop of water that a drop of water bears to the earth. But even here the limit had not been reached. Towards the end of the 19th Century it had been found possible to break pieces off these atoms: for example, by the violent collision of other atoms. These pieces were always the same. They are called electrons and have now become almost an article of commerce, for they are the working material of the radio valve. The hot filament of the valve gives off electrons as water gives off steam, and the electric forces in the oscillating circuit control the motions of the electrons.

The older view of the electron is best expressed by regarding it as a tiny lump of electricity which had a little mass- less than a thousandth of that of a light atom as a kind of secondary property of its charge. It was supposed to have a certain extremely minute size, but as a matter of fact the estimate of this size rested on purely theoretical arguments and no one had ever measured it. However, it soon became apparent that each atom contained electrons varying in number from one each to nearly 250 each for different kinds of atoms. Thus it was reasonable to suppose that an electron was a good deal smaller than an atom.

Later on—it is difficult to give an exact date--it became clear that there was a second universal constituent and that this was the residue of a hydrogen atom when one electron—the only one —was removed. It has been called the proton. Every atom contains, in its normal state, an equal number of electrons and protons. The protons are much the heavier of the two, but they occupy only a very small region in the center of the atom called the nucleus. This region is so small that the combined nuclei of a man's body would form a barely visible speck. Since the nucleus also contains some electrons these apparently must be at least equally small, and we are left with a picture of matter as mostly emptiness. That such a view is not purely figurative has been shown in a striking manner recently. It seems certain that some stars known as "white dwarfs" are so dense that a cubic inch would weigh a ton. This is still nothing like the density of a nucleus but it shows at least that an ordinary solid must have plenty of gaps if it can be compressed to such an extent.



Courtesy of Nature (London)

In the author's experiment rings were produced on a photographic plate by electrons scattered systematically in passing through a gold film. The pattern is interpreted as due to electron waves. See the text, page 40

The picture of matter was thus essentially one of discontinuity. It consisted of a number of specks- of a whole number, for an electron or proton can not be split. It is a return to the earliest philosophy, for it was Pythagoras who taught that "all is number."

But there was another side of physics in which continuity was supreme. If you had asked the question "How does one electron act on another," the answer would have been "through stresses in the ether." Now the ether has had a long and checkered history. Ethers of a sort were common in early physics—rather too common. But the ether first acquired an assured status in the scientific world when it became clear that light had to be explained as *waves*. As this introduces the other half of the title of my paper you will perhaps allow me to dwell on it in some detail.

The obvious thing about light is that it goes in straight lines- as can be seen if you watch light passing into a darkened room through a small hole and tracing out a path as it lights up the motes of dust. Now Newton said that a particle free from force goes in a straight line. It was natural to suppose that light consisted of a stream of particles shot out by the luminous object. Light can be reflected by mirrors and refracted by glass but, superficially at least, these effects can be explained as a rebounding of the light particles, or their deflection by forces at the surface of the glass, as the case may be. Nevertheless, influential men such as the Dutch physicist Huygens suggested in the 17th Century that light was a form of wave motion. Now sound is wave motion and every one knows that sound will go around corners. So will water waves. How can you explain the rectilinear propagation of light on this view?

It is all a question of the wavelength. Even in sound a high-pitched note is not heard well round a corner. If the wavelength of light is small enough rectilinear propagation is all right. Also light does bend very slightly. The really crucial test is what is called interference, the property by which two lights can produce darkness. A special form of this is to take a number of regular spaced wavelets, all derived from one wave. This gives a peculiarly marked effect. The effects of the combined wavelets are strongly concentrated in a few privileged directions and cancel everywhere else.

LIGHT shows this phenomenon to a very marked extent. For example, in the case of the diffraction grating, light scattered from a large number of regularly spaced scratches on a glass or metal surface is found to be concentrated in a few directions, and this effect can be used to measure the wavelength of light with very great accuracy.

The ether was required to carry these light waves. At first it was thought of as a kind of jelly, and Lord Kelvin used immense mathematical skill in finding the very peculiar type of jelly which alone gives exact agreement with the experimental laws of light. Now Faraday long before had regarded electric and magnetic effects as stresses in a medium, and Maxwell showed that the same medium could do

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*From the George Fisher Baker Lecture, delivered at Cornell University, and reprinted by courtesy of *Science*

†See "Among Our Contributors," page 5

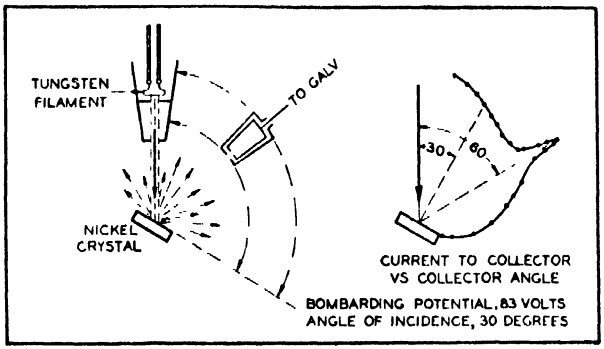
double duty—carry electric effects and transmit light. Hertz crowned the theory by actually producing waves by purely electromagnetic processes which had the velocity of light, and in fact were invisible light: "light" whose wavelengths were to be measured in meters instead of thousandths of a millimeter as are those of the visible kind. I need hardly say that these waves are those now used in radio.

Later it was shown—not until 1913 indeed, but logically it comes in here that X rays are invisible light, on the other side, as it were. Their wavelength is about 10,000 times shorter than that of ordinary light instead of millions of times longer. The way in which this was proved is of interest. To show interference well, one needs an apparatus so exactly shaped that the errors are smaller than the wavelength to be tested. Now X-ray wavelengths are smaller than most atoms. It is impossible to shape an apparatus exact to an atom. Von Laue got over the difficulty in a very ingenious way. He remembered that in a crystal the atoms are arranged in regular order like soldiers drawn up in close formation.

The result is a series of lines like a diffraction grating and about the right distance apart. Actually it is a little more complicated because the atoms are arranged in a solid array, while an ordinary grating is on a plane, but this does not really matter. The result of sending X rays through a crystal is a diffraction pattern, and in this way the wavelengths can be found.

SO far, then, we have matter made of discontinuous particles, while the interaction is due to a continuous medium which can transmit waves. But now came the difficulties. I will take two selected ones which are enough to show their nature. When light is allowed to fall on a polished metal surface, electrons are thrown out from the metal. Since light is electromagnetic waves and electrons are electrical, it is not surprising that there should be an action of this kind, but the details are all wrong. The speed with which the electrons come out does not depend on the intensity of the light. They come out with just the same speed for the feeblest light as for the strongest, only there are fewer of them. Now if, for example, sea waves are breaking on the beach and rolling the pebbles about, the more violent the waves the farther the pebbles are thrown. If the water waves behaved like light, an almost calm sea would throw a few selected pebbles as violently as a great storm throws them all. This is obviously contrary to one's ordinary conception of waves, and it is equally at variance with the results of a complete mathematical treatment. Moreover, the energy with which the selected electrons appear is so great that they would take hours to absorb it from feeble light, while even with the feeblest light there is no detectable lag between switching on the light and the appearance of the electrons. Obviously something is wrong.

Einstein suggested that the light contained units of energy or quanta which behaved practically like particles. When one collides with an electron it gives up its energy to the electron which then can escape from the metal. All the quanta in a given kind of light are the same, but the stronger the light the more numerous they are. The energy of each quantum is the frequency of the light multiplied by a quantity "h," which can be found by measuring the energy of electrons emitted by light of known frequencies. This has been done by Professor Millikan. He finds $h = 6.55 \times 10^{27}$.


TUNGSTEN FILAMENT
TO GALV
NICKEL CRYSTAL
30
60
CURRENT TO COLLECTOR VS COLLECTOR ANGLE
BOMBARDING POTENTIAL, 83 VOLTS
ANGLE OF INCIDENCE, 30 DEGREES

Courtesy Bell Telephone Laboratories

In measuring electron scattering, the "electron gun" at upper left corner sends a steady stream of electrons to the crystal, which scatters them in various directions. The collector (marked "to galvanometer") catches more or fewer electrons according to its position. In the case at right, for example, the maximum number of electrons caught was at 60 degrees angle. This is the principle of the method used by the physicists Davisson and Germer of the Bell Telephone Laboratories

Now this is all very well for the photoelectric effect, as the above is called, but what about the diffraction grating? We have just decided that light must be waves and now it turns out to be particles instead, for it is essential for the explanation that the quanta should be so concentrated that one electron can catch a whole quantum. This is the famous photoelectric paradox.

Before I try to answer it, I will describe the other difficulty. Atoms can be made to emit light, and each atom emits its own characteristic wavelengths. These are clearly a consequence of the structure of the particular atom, presumably of the arrangement of its electrons. Now one theory, and one only, was found capable of explaining these wavelengths even in general terms. This was the theory due to Neils Bohr according to which the electrons were supposed to move in orbits 'round the nucleus rather like planets 'round the sun. But in order to make the theory fit the facts, Bohr had to assume a behavior of the electrons which is quite contrary to ordinary dynamics, and curiously enough the same quantity "h" came in, though in quite a different way.

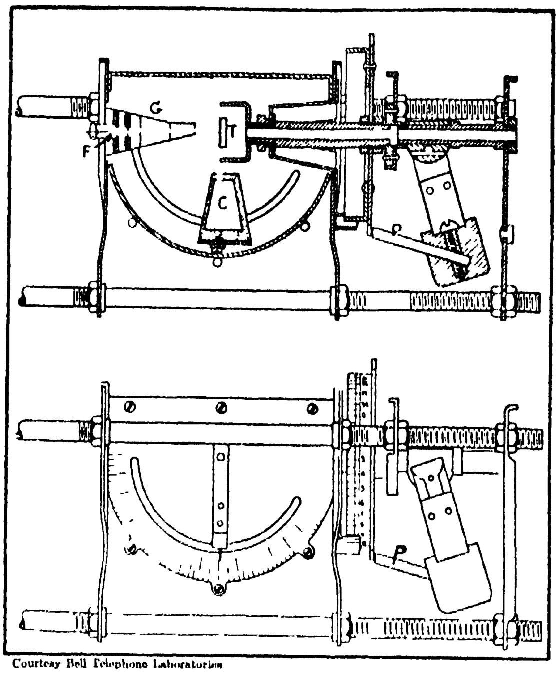
The real trouble was not so much that the electrons obeyed different laws from those of Maxwell and Newton, but that they were not consistent about it. Some of the things they did required the old laws to explain them; others required a new and inconsistent set. Sometimes both had to be used in different parts of the same calculation. The position of a physicist investigating an atom was rather like that of a man trying to make sense of an account of a game which started as golf and suddenly for no apparent reason turned into tennis and then back to golf again. Worse still, as time went on it became clear that the electrons did not play fair even at the game they had for the moment chosen. The results were nearly right but not quite. The only hint was that the quantity "h" came in whenever the atom chose to break the old rules, and this suggested a connection with the photoelectric paradox.

The first really successful attempt to solve these difficulties is due to Prince L. de Broglie. [See SCIENTIFIC AMERICAN, March, 1930, page 183.—*The Editor.*] He realized that the reason why the electron in the atom seemed to follow two different sets of rules at once was that it was behaving much more like a wave than a particle.

NOW if you think that you are reading an account of a game played with a ball, when really the reporter was writing about a swimming match, it is not to be wondered at if the report does not make good sense. It is perhaps surprising that the physicists made as much of it as they did De Broglie's theory was a mathematical one based on relativity. He reached the conclusion that any moving particle would be accompanied by a wave, and he postulated that this wave controlled the motion of the particle. Instead of Newton's laws of motion (motion in a straight line, acceleration proportional to the force, and so on) this view gives a motion governed by waves. Of course Newton's laws are true in every-day life. This is because a very short wave is indistinguishable in behavior from a particle, and the scale of de Broglie's waves is given by "h," which is a very small quantity.

But according to his theory the smaller the particle the longer the wave. For an electron in an atom the wave is quite comparable with the size of the atom, and the behavior of the electron is greatly different from what you would expect of a particle. It has been found in fact that this theory, when fully applied mathematically as it has been by Schrödinger and others, brings order out of chaos in the explanation of the properties of atoms.

Further, it is capable of dealing with the photoelectric paradox. Granting that there are in fact quanta, or particles, in radiation, they will inevitably be accompanied by waves which will guide them. The quota will appear where the waves are strong; where there are many quanta the light will be intense.



Courtesy Bell Telephone Laboratories

The actual apparatus devised by Davisson and Germer for exploring in three dimensions the space surrounding the target *T* of electron gun *G*. Angle of electron collector *C*, may be varied by means of curved slide; also target can be rotated (see dial on lower section drawing of same apparatus). Galvanometer connected to collector *C* registers the number of electrons

IN other words, the regions of brightness and darkness will be just those predicted on the wave theory. This way out had indeed been suggested before. It turns the flank of the difficulty by saying that it is the natural way for a particle to behave. But if you accept this you must be prepared to take the consequences. A free electron, such as a cathode ray, should also be guided by waves and should also show diffraction. How could we hope to detect it if it did? Calculation shows that the wavelength of a free electron of manageable energy is of the same order as that of X rays. Can not we use a method similar to that by which the waves of X rays have been measured and take advantage of the regular structure of crystals?

Successful experiments on these lines have in fact been made by Dr. Davisson and Dr. Germer[1] in this country and by myself and others in Scotland. In my own experiments a narrow beam of fast electrons, cathode rays, in fact, pass through a very thin film of metal. The metal scatters the electrons, and since metals consist of a number of minute crystals, the scattering occurs predominantly in certain privileged directions, just as is the case with X rays. Accordingly, if the electron strikes a photographic plate placed somewhere behind the thin film we should expect to get a pattern similar to that produced by X rays of the same wavelength.

This expectation is in fact realized. I have obtained these diffraction patterns from a considerable number of metals. In all cases the patterns are in exact agreement with what is to be expected if they are regarded as the result of diffraction of waves by the known crystal structure of the particular metal used. The patterns are in general formed of concentric rings just like the familiar Debye-Scheerer X-ray powder photographs. From the sizes of the rings it is possible to deduce the wavelength of the waves causing them, and I find in all cases absolute agreement with the theoretical expression due to de Broglie, $\lambda = h/mv$. Thus instead of being scattered irregularly by the metal, it appears that if the film is thin enough it will guide the electrons into the direction which would be taken up by waves diffracted from the crystal structure of the metal.

If you accept the experiments as showing that electrons behave as if guided by a train of waves, you will agree that de Broglie's idea brings a remarkable simplification. Both electrons and light quanta are on the same footing as particles guided by waves.

The difficulties of physics in the earlier years of this century were due to ignorance of this dual character. For some reason we had got hold of the wave aspect of light and the particle aspect of electrons, and were running each to the exclusion of the complementary view. It also explains the curiously confusing nature of the difficulties. If we had neglected, say, the wave aspect in each case, all the new facts would have pointed to waves. As it was, some pointed to particles, and some, as we now know, to waves.

This dual aspect of things as waves and particles must be very fundamental in the world. There is little doubt that protons would show it also, though experimental proof has so far not been possible[2]. There is even strong, though indirect, evidence that a completed atom has a wave as a whole as well as component waves for its individual electrons. One reason for regarding the duality as really fundamental is that it holds for such different things as electrons and quanta. For in spite of this one point of resemblance they are essentially different. The electron has electric charge and hence is influenced by electric and magnetic forces in a way that the quantum is not. The quantum always goes (*in vacuo*) with a speed of 300,000 kilometers a second. The electron can go with any speed, provided it is less than this. For equal wavelengths the penetrating power is quite different.

These differences make it all the more significant they should both show the same curious duality. The new view is not by any means free from difficulties. To take the most obvious, many electrons form part of each of the atoms of a crystal, yet the experiments I have described essentially involve the idea that the wave of the moving electron is spread over a number of the atoms in the crystal. Have we proved that the part is greater than the whole? I think that even modern physics is not so paradoxical as this. It depends on what you mean by the size of an electron. We can measure the size of atoms in a fairly definite way by finding how many can be packed into a given space of solid. It is rather like measuring the size of shot by counting how many will fill a cartridge case of known volume. Of course we have to allow for possible empty spaces between, but this can be done if we know how they are piled together, and in many cases we do. The sizes are not quite definite; they vary a little with circumstances, but this is not surprising.

SUPPOSE that you want to know the size of a tennis ball. It is easy enough to measure it to an accuracy which will satisfy the authorities at Wimbledon that it is legal, but if you were asked to give its diameter to a hundredth of an inch there would be difficulty. Are you going to measure it to the farthest-out hair of the felt? Obviously that is not a very important measurement, but where are you going to stop? There is no sharp edge. Here a rough measurement has a real and useful meaning, but if you try to make it precise beyond a certain point it can be done only by making some arbitrary convention, such as how hard the measuring instrument is to press.

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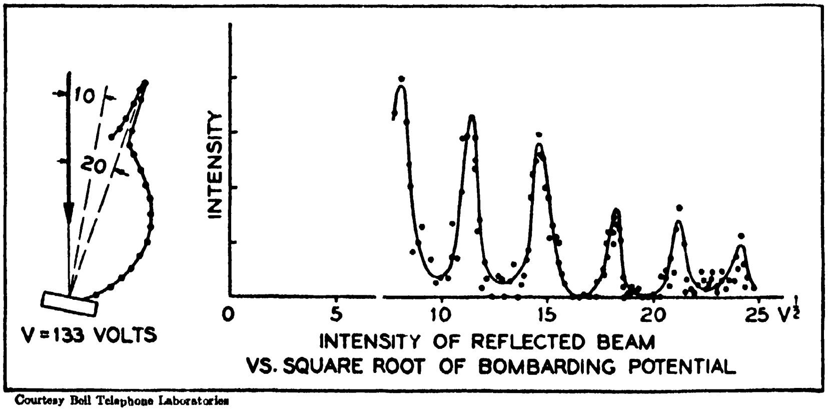
[1] See page 7.

[2] Soon after Dr. Thomson made this prediction it was made good by Professor A. J. Dempster of Ryerson Laboratory, University of Chicago. See our April number, pages 263 and 264.—*The Editor.*

This is the case of the atom, but for the electron the size is even less definite. It has not got even an approximate boundary, as far as our present knowledge goes. It is more like a gas which can expand to "fill" (in a sense) any vessel into which it is put, and yet can be compressed into a very small space. When an electron is part of an atom, its waves curl round, as it were, on themselves until it occupies only the atom, and perhaps only a part of that. When it gets free from the atom as a cathode ray, or escapes from the filament of a valve or vacuum tube, its waves can uncurl and expand indefinitely. I think, however, that in all cases one must consider it as also having a sort of center, even if this is only a mathematical point. Whenever an electron produces any detectable effect it does so as a particle, and it seems easiest to suppose that even when it is not producing an effect the particle is somewhere 'round. The best analogy I have been able to find for this view is a gossamer spider.

WHEN this little animal is clinging to the stalk of a plant, it is a small solid object. When it wants to move it shoots out long filaments many times its own length. The wind catches these and wafts it away. I regard the filaments as analogous to the waves which surround the electron, while the body of the spider is analogous to the central point. One can press the analogy further. If the wind carries the spider so that one of its filaments is caught in an obstacle, the spider will be swung around and its path deflected although its body has not hit anything solid.



Courtesy Bell Telephone Laboratories

Davisson and Germer also measured the selective intensity of the reflected beam of electrons as a function of speed (potential) of bombardment of target. "We find," says Dr. Davisson, "that it passes through one maximum after another as the speed is increased." (Note curve.) These classic experiments are comprehensible on the hypothesis that electrons are "trains of waves of wavelengths comparable to distances between atoms in solids." All these famous experiments were performed in 1928

In just the same way with the electron, if its waves pass over an obstacle, say an atom, the direction is modified and this modification is transmitted back through the wave system to the electron itself. If we suppose that the electron is constrained always to move in a way determined by the waves in its immediate neighborhood, the motion of the electron itself will thus be modified. The waves thus act as a kind of intermediary between the disturbing objects and the electron itself. The electron goes where the waves in its immediate neighborhood carry it, just as the spider is pulled by the parts of the filaments which are actually attached to it. But the form of the waves, near the electron, is determined by events at a distance, whose effects are propagated through space in the form of waves.

A question that inevitably arises is—what is the medium which transmits electron waves? I am sorry that I can give no entirely satisfactory answer. For the first time, physics is faced with waves in empty space which do not fit into the ordinary series of ether vibrations. All the ether vibrations differ only in wavelength; if the wavelength is given, the kind of "light" is fixed. The electron waves have varying wavelengths, depending on the speed of the electron, but they usually fall in a region of wavelengths which is already appropriated by X rays. As we have seen, they are certainly not the same as X rays. One must suppose some other medium, or at least that the ordinary ether is in some way profoundly modified by the presence of the electron. It is possible that they are waves in a "subether." But it is not a very attractive idea to have two ethers filling space, especially as the waves of protons, if they exist, would demand yet a third. Space is getting overcrowded.

Other suggestions are to regard the waves as a kind of mathematical abstraction, a sort of ghost waves. The whole question is getting very metaphysical. Perhaps a simple physicist may be content as long as the waves do their job of guiding the electron, and it is possible that, after all, the question will ultimately be seen to be meaningless. Whatever the medium is, the new wave conception has altered the view we take of the best answers to the question with which I began this lecture. Matter is still supposed made of discrete units, but instead of these units moving by laws which concern them alone as did the laws of Newtonian dynamics, we have had to introduce laws based on waves. Now a wave is essentially a continuous thing, even if the continuity is only mathematical. It is spread through space, not divided into little lumps. So although the older belief in the discontinuity of matter still holds, it has lost some of its rigidity; continuity has crept in by the back door.

The idea of the ether has also changed. The sole function left it is to guide the quanta; they do the work. The picture of light as waves breaking on a shore of matter, and thus disturbing it, is replaced by one of a stream of bullets which affect only the particular objects which they hit. The bullets, it is true, do not move quite as ordinary bullets would; they are directed by the waves, but all the effects are bullet effects, not wave effects.

WE have seen that Newtonian mechanics needs modification; that it is a simplification which is permissible only when the wavelength is very small. This of course does not detract from its practical value in every-day life and in astronomy, nor from our estimate of the genius which gave it a form which has satisfied two and a half centuries. On the contrary, the new developments, as far as they concern light, which I have tried to explain to you at such length, are much better expressed in the words of Newton's Optics. "Those that are averse from assenting to any new discoveries but such as they can explain by an hypothesis, may for the present suppose, that as stones by falling upon water put the water into an undulatory motion, and all bodies by percussion excite vibrations in the Air; so the Rays of Light excite vibrations in the refracting Medium or Substance . . . that the vibrations thus excited are propagated in the refracting or reflecting Medium or Substance, much after the manner that vibrations are propagated in the Air for causing Sound, and move faster than the Rays so as to overtake them . . and that every Ray is successively disposed to be easily reflected or easily transmitted by every vibration which overtakes it. But whether this Hypothesis be true or false I do not here consider."

After being regarded for generations as an artificial attempt to save a dying theory, we have proved this guess of Newton's to be a supreme example of the intuition of genius.

Jujube trees are being propagated in the foreground of this scene which shows the greenhouse and nursery at the Chico station

An Immigrant Plant Proving Ground

By Charles W. Geiger

FEW Americans realize that plant introduction has given to the United States practically all of its commercial crops. Thousands of the new plant immigrants that enter the country each year find their first home in the plant introduction field stations, or gardens, of the Department of Agriculture. These are the "Ellis Islands" of the plant immigrants, but they also are the workshops, field laboratories, and plant propagation factories of the Office of Foreign Plant Introduction.

The United States Plant Introduction Garden near Chico, California, is the largest government-owned and operated garden of its kind in the United States. This station serves the State of California primarily, and other regions on the Pacific coast generally. It is located in one of the leading deciduous-fruit, nut, and citrus sections in northern California. The high summer temperature, abundance of water for irrigation, long growing season, and mild winters of this region make possible the propagation and testing of such widely different species of plants as alfalfa from the steppes of Siberia, hardy apples, pears, and cherries from Russia, chestnuts, jujubes, and persimmons from northern China, and citrus fruits from the tropics.

The Chico station consists of 210 acres of land, three hot-houses, and office and residence buildings. The entire garden is under irrigation, the greater part of it under a pressure system. For the entire garden there is an electrical installation of approximately 30 horsepower for pumping service.

CHICO is primarily a propagating and testing station. The plants are tried out there and if they seem promising, they are then distributed for experimental purposes, on order from Washington, to state experiment stations, botanic gardens, arboreta, and similar institutions. There is, in addition, a list of qualified experimenters to whom material is sent when there is more than that required by the regular research institutions.

The thousands of new plant immigrants annually received in Washington in the form of seeds, plants, cuttings, and so forth, from the agricultural explorers and correspondents of the office, are unpacked and given an identification number in the specially equipped plant-inspection laboratory of the office. If a plant immigrant is found to be affected with insects or other pests or with diseases, it is ordered into quarantine, and the necessary treatment is prescribed and administered. If found to be free from insects and diseases, it is given a clean bill of health. It may then be forwarded to the experimenters within the department for whom it was especially secured, or to the plant introduction garden at Chico, California; Coconut Grove, Florida; Bell, Maryland; or Savannah, Georgia. The selection of any particular one of these four gardens depends largely on the character of the plant.

THE plant propagators at these gardens have frequently to resort to every known practice of the craft to save an introduction which arrives out of season or in a critical condition; and in some instances, when the plant introduced is unknown and no information regarding its identity can be secured, they must rely upon their own ingenuity in developing methods of handling such material in order to save what may eventually develop into an important new plant industry.

The propagation houses, cold-frames, lath sheds, greenhouses, and other equipment at the plant introduction gardens of the department, together with trained superintendents, experienced plant propagators, and a corps of capable gardeners and laborers afford excellent facilities for the propagation and preliminary testing of the thousands of new plants annually introduced. They also make possible the efficient distribution of new plant material to specialists of this department, state experiment stations, botanic gardens, and to a limited number of private experimenters.

Among the host of interesting new plant introductions which have been propagated at the Chico station, a few selected examples will give some idea of the range of species handled and the variety of the problems presented.

The jujube, or so-called Chinese date, is a promising plant for California and the semi-arid south and southwest. The experimental tests made with this alkali-resistant and drought-resistant fruit at Chico, to determine the possible value of the strains and varieties that have been introduced, have been very satisfactory. The fruit of the better varieties is fully as large as a large prune, and reddish or mahogany brown in color when ripe. While the jujube is a very good fresh fruit, it is undoubtedly of greatest value when processed with cane sugar or honey. Prepared jujubes are as delicate in flavor as many dates.

From the seed of the tung oil trees (See page 355, May, 1930, SCIENTIFIC AMERICAN) is made an oil which the paint manufacturers of this country consider one of the best drying oils known to the trade. Trees of this plant immigrant distributed from the Chico garden in 1906-07 are doing well and bearing fruit in many places in the region extending from northern California to and throughout the Gulf States, but appear to be doing best in northwestern Florida and the southern parts of Georgia and Alabama.

It has been well said that there is no other plant which is so intimately bound up with the life of man as the bamboo. Here is a forest of it at Chico

The pistache tree, a promising introduction from central western Asia, presages another new industry for the United States. The small, green-fleshed nuts are delicious when roasted and salted, and are extensively used in the coloring and flavoring of ice cream and confections. Almost the entire supply of these nuts at present comes from abroad. The trees do exceedingly well in the Sacramento and San Joaquin Valleys in California. Seedling trees near Fresno, California, have borne large crops of nuts for some years.

Budded and grafted plants of some of the best commercial varieties have been distributed to experimenters interested in testing out this introduction to determine the possibilities for its cultivation as a new plant industry. The peculiar beauty of the Chinese pistache tree and the great age to which it lives have suggested its trial as an avenue tree, and thousands of young trees have been distributed to parks throughout the country. A trial avenue, a quarter of a mile long, planted at the Chico garden in 1910, has already made an excellent appearance.

THE Chinese varieties of persimmon vie with those of Japan in size, quality, beauty, and hardiness. Many varieties have been propagated at Chico and the special Chinese stocks upon which they are grown in China have been used. The region in which the oriental persimmon can be successfully grown commercially includes California and the South, where the temperature does not fall much below freezing. The culture of this excellent fruit is destined, sooner or later, to develop into an important industry. Dried persimmons form a staple food product of China and Japan.

The Chinese dry-land elm is a promising new plant immigrant. This elm is found throughout northern China and Manchuria and is known to be very resistant to drought, neglect, and extremes of heat and cold. Seedling plants of this elm secured at Fengtsi, near Peking, Chihli, China, in 1908, were grown and distributed from the Chico station. These early distributions proved sufficiently promising to justify its propagation in quantity for distribution throughout the United States. The stock at the Chico garden being limited to a few small trees retained for permanent planting, it was necessary to resort to propagation by dormant hardwood cuttings. Tests with this elm indicate that it is likely to be of very great value for windbreaks, shelter belts, and other plantings in the Great Plains region.

A promising, small, early, sweet cherry introduced from Tanghsi, China, in 1906, was saved to the country by a chance graft. When this introduction was received at the Chico station, the gardener, after working practically all of the scions received upon nursery stock in the usual way, conceived the idea of running the remainder into the small limbs of an old seedling cherry tree. The scion worked upon commercial stocks all perished, but two of those worked upon the old seedling tree survived. In the following spring these grafts were in full flower before the buds of the seedling tree began to swell, and they ripened their fruit by the time the old tree was in flower, or several days earlier than the earliest commercial cherries of that region. From the scions thus saved, a large number of plants have been propagated and distributed throughout the country for experimental tests. At Yuba City and Vacaville, California, this introduction gives promise of being of considerable commercial importance as an early cherry for the eastern markets.

A section of the nursery at the Chico Plant Introduction Gardens

THE Davidiana peach appears to be quite resistant to alkali and drought and well adapted to the deep alluvial soils of California. It is also succeeding at San Antonio and other places in Texas and has stood a temperature of -40 degrees at the State Agricultural Experiment Station, Ames, Iowa, with little or no injury when 50 other varieties, tested in comparison, were either killed outright or seriously injured.

The fruit of this wild peach is small and inedible, but the introduction may, because of its extreme hardiness, prove valuable in hybridization experiments for the production of much hardier types of commercial peaches.

Interest has been maintained in bamboos and their probable uses in this country for several decades. We have no native bamboos worthy of the name, our nearest approach to the many varied and useful forms of other countries being the arundinarias of the southern states. During the past 30 years the Office of Foreign Plant Introduction has imported into this country more than 60 inventoried numbers of bamboos.

An orchard of the better variety of jujube tree at Chico Gardens

Long before the Department of Agriculture inaugurated its systematic work on agricultural explorations, some 30 years ago, bamboos were being brought into the United States in various ways. These unusual and often strikingly beautiful plants naturally attracted the attention of travelers, who found they could be lifted in clumps and kept alive for several weeks. Isolated plantings were thus early established along the southern seacoasts and some of these have developed splendidly.

EARLY in 1908, David Fairchild, in charge of the plant introduction work of the Department, inaugurated some extensive measures for bamboo introduction. The services of W. D. Hills were obtained in Japan, and he was authorized to get together, grow, and ship to the United States a large collection of three or four varieties of the most important economic bamboos. When Mr. Hills had completed his plans he returned to the United States in the autumn of 1909, on an Army transport, bringing 3500 bamboo clumps with him. The plants were divided into two lots, one being sent to William Tevis, Bakersfield, California, and the other to the Plant Introduction Garden at Chico, California.

The clumps sent to the Tevis place were planted in the open ground in January, when it was cold, and although the best of care was given them, most of the plants died. The Chico shipment was put in a greenhouse and carefully nursed. Heat was supplied and plenty of water given. These plants came through in fair shape, and most of them were shipped to a garden at Brooksville, Florida.

It is impossible to foresee what the future has in store for the bamboo in the United States. That this group is worthy of study and effort is beyond question. Who knows that some day these giant grasses may play an important rôle in our welfare. As our forests disappear and the need is more and more felt for quick-growing and easily worked wood material the bamboo may find an important place here as it has found a vital niche in the scheme of things in many countries of the world.

A Clearing House *for* Inventions

AMONG the many things which have contributed to the development of American business, two infrequently stressed factors stand out significantly. One of these has been the remarkable ingenuity of American inventive genius; the other has been the flair of American business men for commercializing inventions. And yet until quite recently no organized facilities have existed for the promotion of new ideas. American finance, highly organized in all other branches, has left this important field to unorganized or casual direction.

It is common knowledge that the typical free-lance inventor is a lone worker who pursues his own ideas in his own way, often under obscure conditions; and it is rather a strange circumstance that the American inventor today is as much at a loss to know where to turn for the commercialization of his ideas as he was 50 years ago. In the meantime practical and profitable contact between industry and inventors is urgently needed. Every industrial concern today is in danger of having its product or products not only equaled but in some cases bettered or entirely supplanted. Obviously the one effective means of anticipating this serious competition, with its resultant slowing up of production, is to have adequate and systematic access to the wide and growing field of free-lance invention.

EVERY year inventive genius produces thousands of new inventions and numerous new industrial processes. Sometimes they justify the incorporation of separate companies but more often they call for absorption by established industries; that is, if they are properly brought to the attention of those that need them. The inventor, as has been implied, is too often an impractical business man.

Now, however, there is being assembled a group of manufacturers in an organization which will persistently search out new inventions and endeavor to place them in the hands of manufacturers most likely to be interested in their production. This corporation is Campbell, Peterson & Co., Inc., who have had seven years of specialized experience in the examination, selection, and development of new things, and have now evolved a collateral service which provides, on an organized basis, an experienced clearing agency for inventions.

Directed by men of prominence in industry and finance, who are also officers and directors of companies the combined assets of which total over five billion dollars, this corporation is an organized agency to which inventors may submit their ideas for study, classification, utilization, and financing. Fortunately the organization which undertakes this task has already been able to demonstrate in its own experience the practicability of its procedure. Since its inception in 1923 the company has developed through private development syndicates five interesting businesses based on new inventions.

As a clearing house for inventions and the utilization thereof, this organization is setting up an industrial intelligence service which will consist of an investigating and research department and an industrial service department with widespread domestic and foreign affiliations.

THE industrial service bureau will solicit, through advertising and contact, newly invented machines, devices, processes, and so forth, from various sources. It appears conservative that the number of inventions which should thus be made available will range from 10,000 to 20,000 per year, based upon the fact that without advertising or other solicitation the company has received in the past well over 1000 inventions annually. Among the sources which will be canvassed are free-lance inventors, research laboratories of technical institutions, patent attorneys, industrial advisers who have inventions submitted to them, reports of technical societies, et cetera.

In regard to foreign affiliations, the organizers have knowledge of one foreign agency which is now successfully operating and which, it is reported, has access to new inventions of central Europe. This agency, which is headed by prominent European industrialists, has expressed its interest in effecting a working agreement with the American company. Already affiliations have been established for the purpose of attracting new inventions from most of the countries of Europe. It is planned to secure through these foreign affiliations representation in all of the principal industrial cities of the countries concerned.

The present investigating department will be expanded so that its facilities will be adequate for investigating all proposals meriting more than preliminary examination. The staff of this department, trained for this purpose and experienced, will assemble and study products and inventions submitted, and satisfy themselves as to their elements of originality and commercial possibilities. It is expected that this department will provide a steady stream of analyses of new and unappropriated inventions suitable for the consideration of American manufacturers.

THE information service will be made available to suscribing members in the form of printed bulletins, and drawings or photographs if these are available. Any subscriber desiring further information on any invention may arrange for a further discussion of details. When the matter progresses to a point where purchase or license of a device or patent is contemplated, the subscribing member may either negotiate the matter direct or he may retain the service of the organization. The list of subscribing manufacturers will be limited in number to 200, including one company in each field of industry as those fields have been distinguished in a careful survey. Inventions will be placed outside this selected group when they are not wanted within the group.

Contact will be maintained with subscribing members not only through the distribution of information in printed form but also by special letters or other communications calling attention to the possible use of certain inventions to meet the particular needs of subscribing members. Regular visits to plants or offices of subscribing members will be made in order to ascertain their needs and increase co-operation. Inventors will be notified of manufacturers' needs and encouraged to co-operate in the solution of their problems.

As occasion arises for the financing of such inventions or processes as are deemed suitable for building into individual industries, the company will form underwriting syndicates.

The inventor who wishes to capitalize his "brain child" but admits a lack of the necessary knowledge of financing problems, who has not the industrial contacts, or who cannot or does not wish to spare the time attempting to sell it to some manufacturer, may thus have all the details attended to by this new well-supported organization. Its liaison service promises a solution to the inventor's problems. With his invention in their hands, the inventor stands a better chance of having it commercialized than if he attempted to do the job himself—and at a nominal cost; and he may then turn his thoughts to other inventions or projects.

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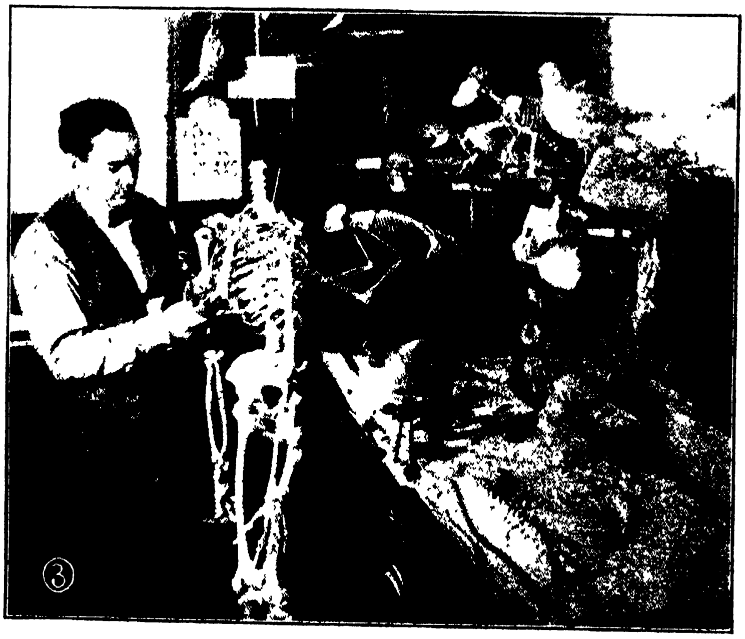
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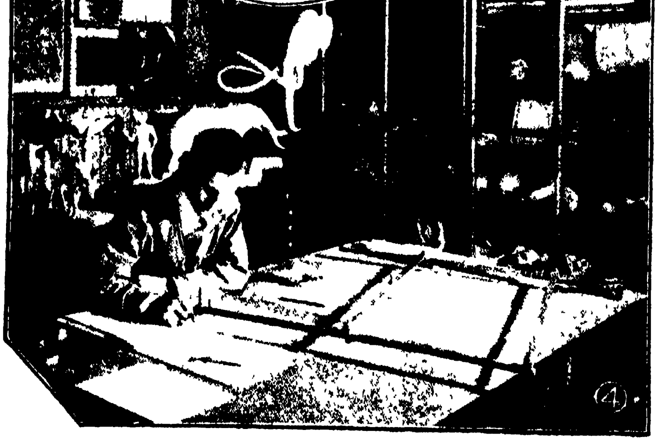
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ON THE OPPOSITE PAGE

1. Here we see the pioneer staff in the early nineties. These men were osteologists, geologists, zoologists, microscopists, mineralogists, ichthyologists, and anatomists or preparators. Many of them became prominent figures in the educational world. One of them has worked for this institution for 56 years

2. Preparing a rock specimen. The rocks are first broken in the mineral trimmer and then are finished with the hammer

3. Articulating a human skeleton. The osteologist is adjusting the arm so as to permit of the proper movement. Note the picturesque specimens and tools

4. A step in the production of a contour map. Mr. Blackstone is shown enlarging with a pantograph. Relief maps are largely used for educational purposes

5. The artist's corner. Here the expert, Miss Waters, is putting the finishing touches on a scientifically accurate model of an extinct animal, the *Archisaurus*

Mr. Oscar Kirchoff, head of the Department of Biology, is shown examining gorilla skulls which have just been received. The fine collection is unique

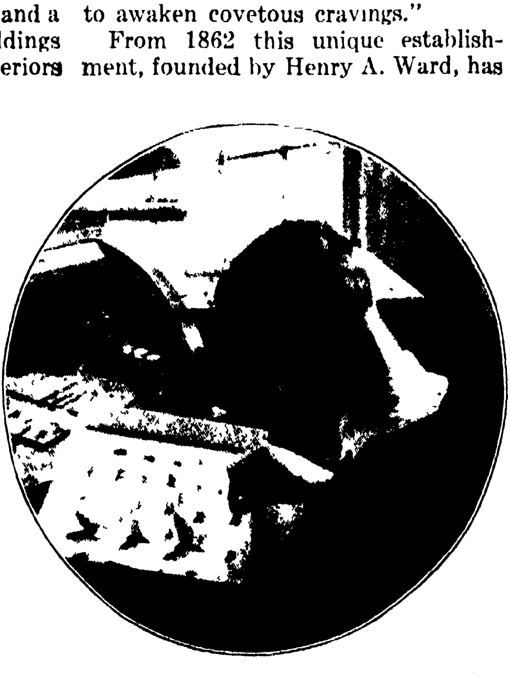
America's Cradle of Natural Science

A Curious Industry Owned by a University to Supply the Needs of Colleges

NESTLING near the University buildings at Rochester, New York, is an interesting group of old buildings where natural science in America may be said to have been cradled. Here was the incubator where many of the leading museum directors and curators of today served their apprenticeship. Among the great names are Carl E. Akeley, Dr. F. A. Lucas, Dr. Wm. T. Hornaday, Prof. James Orton, Dr. Chas. H. Townsend, Dr. Henry E. Crampton, Dr. C. E. Cummings, and a dozen others. The group of buildings are very unpretentious but the interiors are highly picturesque, as will be seen by the illustrations. In the early days taxidermy was in its "upholstery" period. This means that you stuffed an animal the way you would a chair. Akeley changed all this and here is where he learned the art which he was to regenerate.

It might be asked "What is a natural science establishment?" This can be answered best by a quotation from an old circular of the nineties. "This is a serious scientific institution; a great clearing house to which are brought and from which are distributed objects in all departments of nature. These objects we first collect, then prepare, determine, label, and gather into classified series, compiled to suit the needs of museums and educational institutions of all kinds. The general public knows of the establishment as the little village on College Avenue with the whale jaws over the main gateway—where Jumbo was mounted—and where can be seen curios from every clime. To the small boy this is a benevolent institution, where cats, turtles, birds' eggs, snakes and other vermin can be converted into cash. To the naturalist we are a place of terrible temptation, where rare and beautiful specimens of all kinds unite to awaken covetous cravings."

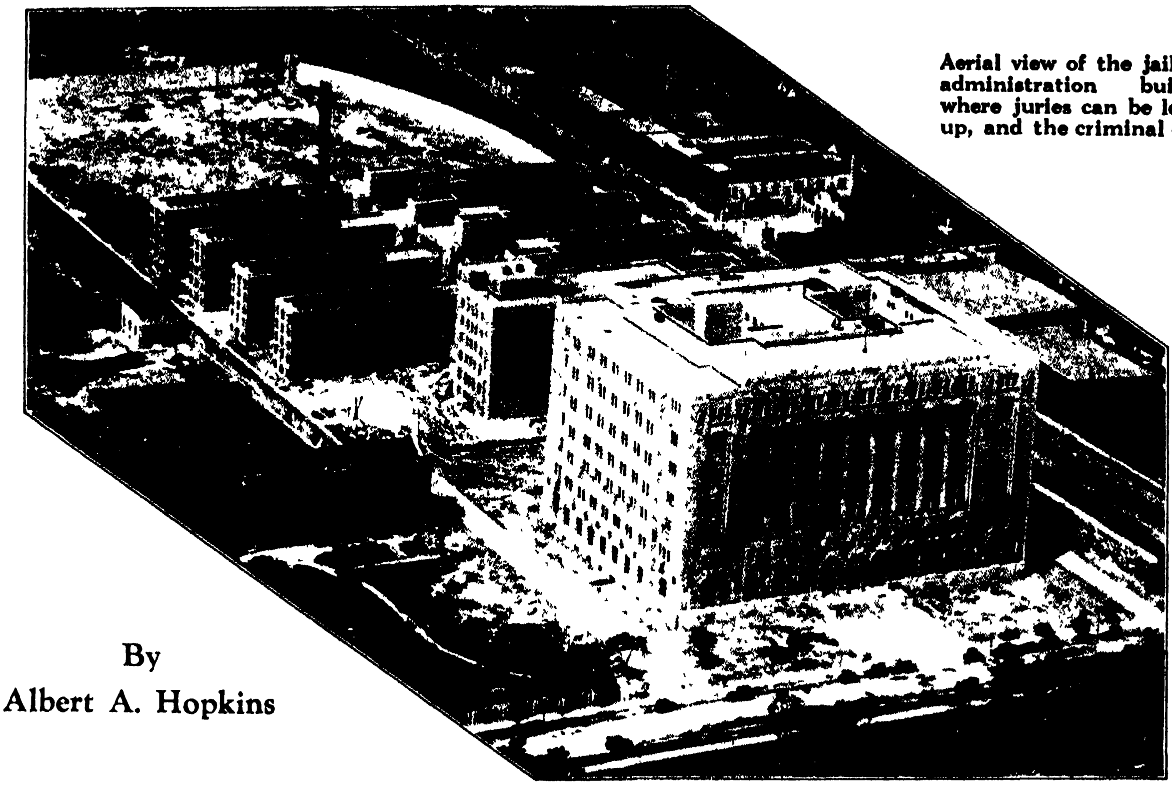
From 1862 this unique establishment, founded by Henry A. Ward, has had no rival. When colleges were indifferent to natural science Mr. Ward held the lamp aloft and kept up interest in the subject. In the period of its existence it has issued 295 circulars and 43 catalogues; the last one (issued only recently) is a valuable reference work of over 200 pages Among the subjects listed are scientific models, charts, skeletons, zoological material for exhibition and demonstration, entomological specimens and supplies, zoological material for dissection, microscope slides, paleontological specimens, relief maps, geological models, and mineralogical specimens of all kinds.



Mr. Ocorr is transferring to a case specimens of insects which have been expanded

ON January 1, 1928, the ownership of Ward's Natural Science Establishment passed to the University of Rochester, the transfer being made as a gift for a memorial to Mr. Frank A. Ward who for over 50 years directed the affairs of the establishment. In taking over the ownership it is not the intention of the University to conduct the establishment as a money-making institution, but rather to make available all such material as can be supplied at the lowest possible prices.

The writer has visited this institution twice and was reminded very much of Mr. Venus's shop in Dickens' "Our Mutual Friend." Here are boxes of shells, boxes of minerals, boxes of bones, all in great mental order but extremely picturesque to look at. Through the co-operation of Mr. F. H. Ward these pictures were secured.



Aerial view of the jail, the administration building where juries can be locked up, and the criminal court

Copyright by Chicago Aerial Survey Company

By
Albert A. Hopkins

Chicago Gets a New Jail

CERTAINLY Chicago was entitled to a new jail and when she got one she got a good one, the cost being 7,500,000 dollars. They tried to build for the future but they can put out the "Standing Room Only" sign right now. Of course we know all about Chicago's crime wave but the new jail seems to be about the only answer that can be made to the gangster, the yegg, and the racketeer. The Cook County jail is the largest jail in the United States, and it is one of the most humane ever constructed. The writer is indebted to Mr. Eric C. Hall, County Architect, of the firm of Hall, Lawrence and Ratcliffe, Inc., who designed the structure and to the engineers of the Van Dorn Iron Works for much assistance in the preparation of the present article.

THE site comprises about ten acres and was formerly occupied by a school. It is next to the house of correction, or Bridewell. The group of buildings includes a stately court house, an extremely efficient administration building, and four units of cell buildings. They are all connected by a prisoners' tunnel and prisoners' corridor so that there can be no attempt at rescue. The criminal court building is a beautiful structure 239 feet long, 181 feet wide, and 139 feet high. It contains 14 regular court rooms besides the manifold rooms necessary for the orderly and rapid administration of criminal justice in a large city.

The second building is of considerable interest as it embodies many new features. This administration building also is of considerable size, being 150 feet long and 62 feet wide. It is divided into independent parts between which there is no connection. One is for the accommodation of 12 juries at the same time. Each jury is provided with a three-room suite, two baths, and a separate dining room. There are three rooms in each suite because, although not yet, of the possibility of juries consisting of both sexes. You never can tell when such innovations will take place. There is also a general recreation room for jurors, quarters for jury bailiffs, separate dining rooms, and the jurors' kitchen. The other part of the administration building is for the superin-

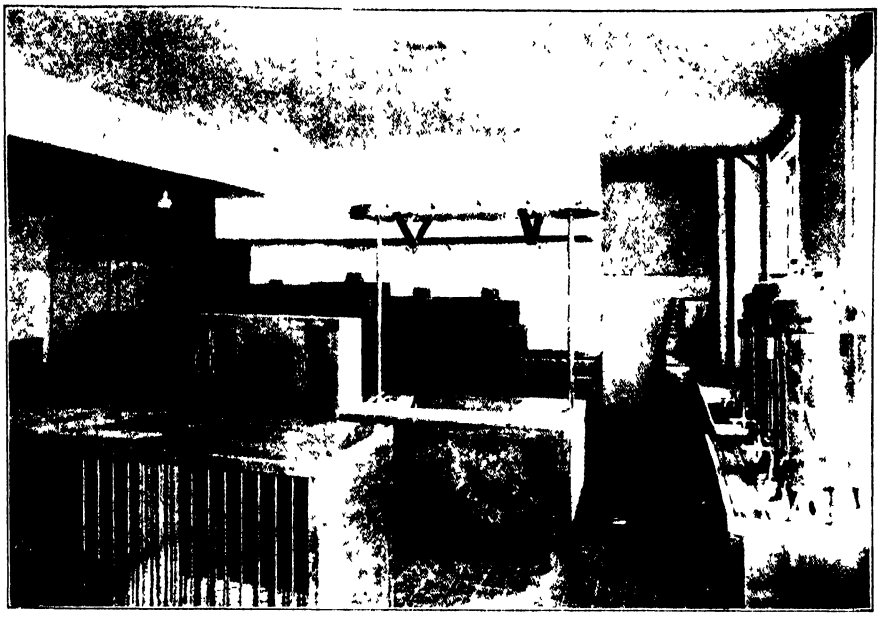
Control compartment enables a guard to direct the movements of 39 detained persons. Doors to cells are opened and closed mechanically from this station tendent of the jail and his assistants and contains facilities for receiving inmates. Looking down from the air a "telegraph pole" is suggested by the disposition of the structure.

The remaining four structures are cell buildings, each consisting of four stories and English basement, 343 feet by 32 feet by 37 feet high. These buildings contain a total of 1302 cells. Additional units can be built as required. The cells are classified as receiving, general, hospital, isolation, and debtors'. They are divided among 36 units. Thirty-two of these are typical, two of them being on each of the four floors of each of the four cell buildings. Each of these typical units is complete in itself, permitting of group classification and segregation of inmates.

THE typical unit contains 39 cells, each five feet by eight feet by eight feet four inches, made purposely so small that it will not provide for more than one inmate at a time, thereby insuring individual segregation. Each of the cells contains a bed, a bench, a drinking fountain, and a push button, with which to signal the guard in the control compartment.

From the administration building access is given to the four cell blocks at the first floor level, and elevators serve to convey inmates, guards, and visitors to the various floors. At each floor there are two guards' rooms facing each other with the public corridor between. Surrounding each of the blocks of 39 cells and separated from it by a grating is the guards' corridor which enables them to walk completely around the cell area. The windows in the outside wall are located opposite every other cell, thus insuring plenty of light and air.

The 39 cells open into a central cell corridor and are provided with doors which are unlocked, closed, and locked by means of a mechanically operated locking device. The control is vested in a control box situated in the isolated guards' room. The central corridor on each floor of each cell block leads into the inmates' recreation room, 20 by 31 feet, where the detained persons eat and spend their time when not in their cells. Adjoining is a serving kitchen, the food being supplied by a dumb-waiter from the central kitchen in the basement. In connection with the recreation room, otherwise known as the "day" room, there are toilets and a shower room.



In the jurors' kitchen in the administration building hot meals are served to jurors who are locked up to deliberate. Twelve juries can be accommodated

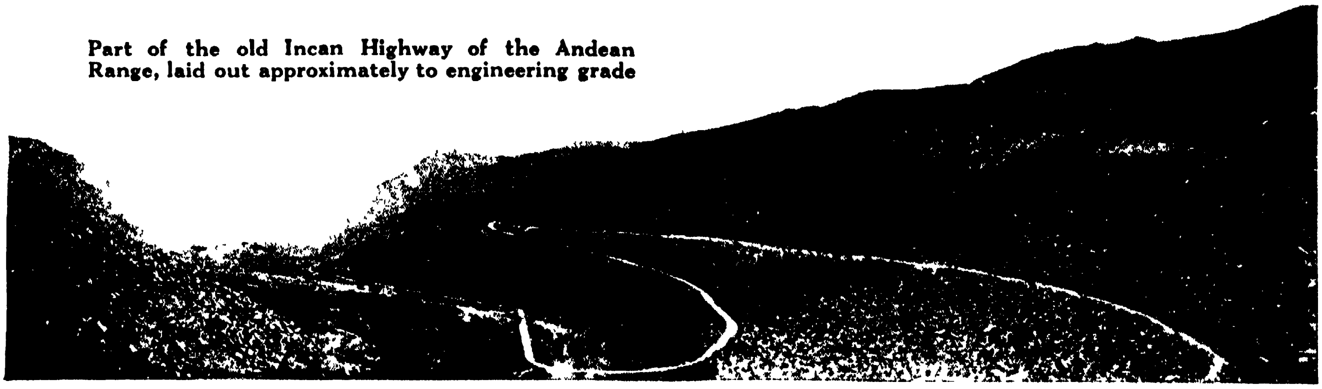
Adjoining the control department inmates can see and talk through glass which prevents passing contraband

In a cell block 39 cells open into a central cell corridor. One guard controls all doors

Adjoining the guards' control room is a space where persons who are detained may see and talk with their friends through shatter-proof glass, which enables a conversation to be carried on without danger of smuggling weapons, drugs, or other contraband. Adjoining the guards' control room is a compartment for inmates to consult with their attorneys.

Each cell door is controlled by the guard from his practically armored room. A semi-circular tool-resisting grill enables him to view the entire prisoners' corridor through the recreation room. When a detained prisoner wishes to leave his cell for any legitimate purpose he pushes a button and his call is indicated on an annunciator in the guard's room. The guard then goes to the proper control box (right or left) and by dropping a small lever he unlocks the cell door in question and permits the prisoner to leave his cell. The guard can then lock the door in an open position, if he so desires, so that it cannot be closed without his sanction.

WHEN the prisoner returns to his cell the guard then closes the cell door by means of the large crank shown at each side of the semi-circular grill. The entire operation of opening and closing the door can be accomplished without disturbing any other cell door. All the cell doors in a single row can be opened at one operation at meal time or in an emergency. The steel in the cell blocks is tool-resisting which means that bars cannot be mutilated by the inmates, under prison conditions. The cells are fireproof.


Part of the old Incan Highway of the Andean Range, laid out approximately to engineering grade

America's First International Highway

By A. Hyatt Verrill

Pre-Incan Aborigines Engineered a "Modern" Highway 4000 Miles Through the South American Andes

IN these days of transportation and traffic problems, of the universal automobile, and of the constantly increasing trend of travel to South and Central America, the proposed International Highway is of the greatest interest to the public. But how many of us know that centuries before the first European set foot on American soil an international highway had been constructed and was in daily use?

To be sure, this highway did not link the two continents, but it linked several great nations; it was over 4000 miles in length. Many of the facts regarding it seem incredible, even with our present-day knowledge of road-building and modern engineering, our massive machinery and labor-saving devices.

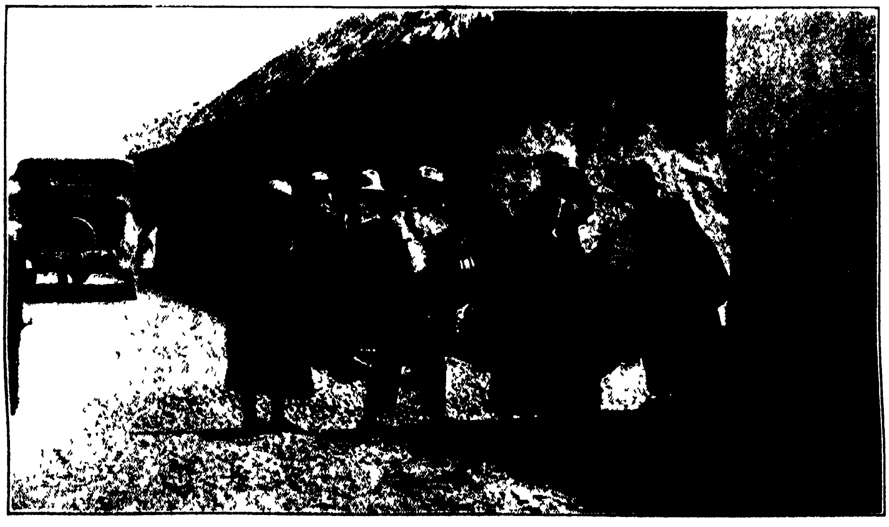
THE International Highway to which I refer was the "King's Road" of the Incas; a road built by the ancient aborigines of South America; by men who, so far as we know, were entirely ignorant of the use of iron or steel; who possessed no true mathematical instruments, no transits, no compasses, no comprehension of engineering as we understand it. Yet they built their marvelous road through country that presents some of the greatest obstacles. Even the Romans never succeeded in building such a roadway and, compared to the Incan road, the famed Appian Way was scarcely more than a trail.

From Quito in Ecuador, to beyond Tucuman in Chile, the Incan Highway followed the general line of the Andes. At intervals, side roads branched off. A second road 25 feet in width, and almost as remarkable as the first, followed the shore line from Ecuador to Chile.

No one knows when this remarkable road system was started, how much time was required for its construction, what it cost in labor and riches, when it was completed or what man first conceived the idea. Although called the Incan Road, and while unquestionably extended, improved, and maintained by the Incas, yet much of the main highway antedates the Incan Empire by hundreds of years. It is the work of the pre-Incan races. The pre-Incans are shrouded by mystery which no one has yet been able to pierce, and we really know nothing about them, aside from the fact that they were a highly civilized race, were wonderful engineers and builders, and left remains in the form of walls, roads, and buildings that are among the greatest of the world's wonders.

The most outstanding feature of their works are their structures of the so-called "cyclopean type," most of which center in and about Cuzco which, later, became the capital of the Incan Empire. No cement nor mortar was used, the walls and buildings being formed of immense stone blocks, often weighing as much as 20 to 30 tons each, and frequently with many angles—cut, faced, and fitted with such amazing perfection that even today it is quite impossible to insert a knife blade between the stones.

That the same people who erected these titanic structures, by means that have never satisfactorily been explained, built much of the great highway is certain. In many places we find the same type of stone work employed in the road construction, and we know from incontrovertible evidence that much of the material, in the form of giant stone blocks, used in building forts and other edifices near Cuzco,


The old and the new. A motor car and Aimerá Indians, descendants of the ancient, powerful Incans, on the Incan Highway on the Peru-Bolivia border

were transported long distances over the ancient highway.

The road was carried up the stupendous heights of the Andes by accurate, easy grades, by wonderfully calculated hair-pin turns, S-curves and zig-zags. It was carried along the faces of precipices on shelves hewn from the solid rock, or upon masonry abutments built up from far beneath. Ravines and chasms were often filled with solid masonry to form causeways over which the road crossed. Where the canyons were too deep for this the abysses were spanned by suspension bridges supported by immense cables of wool, cotton, or fiber rope. Where the way was barred by insurmountable cliffs tunnels were cut through them.

FOR a great portion of its length, this wonderful King's Road was paved, much of it was surfaced with asphalt or bitumen, and so thoroughly well built was the highway that long stretches of it are still in use at the present time. Throughout the entire 4000 miles and more of the road, there were rest-houses for the benefit of travelers, and which served also as relay stations for the couriers of the Inca. There were "Imperial Inns" every 40 miles. These served as storehouses for food, supplies, and equipment for the army or for the relief of neighboring villages in case of famine or war; and as eating places for the army when on the march.

There was also a continuous series of sentry stations, forts, and watch-towers. A very complete system of signal-fires or lights was maintained, by means of which the men who were constantly on watch could transmit messages from one terminus of the highway to the other. At the time of the uprising of the *Caras* tribe near Quito, Ecuador, news of the revolt was thus received by the Incans at Cuzco, Peru, within four hours after the trouble broke out. To transmit a message from the Chilean terminus of the road to Quito, 4000 miles away, ordinarily required scarcely more than six hours.

Although of great importance for peaceful purposes, yet to the Incans, their highway was primarily a military road. Over it their well-trained, well-equipped armies marched to their innumerable conquests. Over it, according to Incan records, trudged 250 carriers, each bending under a burden of gold, the whole weighing more than ten tons, to be used in making the immense gold chain that Inca Huayna Kapac ordered made to commemorate the birth of his eldest son, Huascar. Over it, too, was transported that marvelous, inconceivable store of gold, amounting to 7000 loads of 75 pounds each, that was sent from Chuquis to ransom the captive Atahaulpa, but which never reached its destination. Somewhere along the ancient Incan road, that vast accumulation of precious metal lies hidden to this day, for when word of Pizarro's treachery and Atahualpa's death was brought to the toiling, gold-laden Indians, they concealed the treasure in some secret spot near Piscobamba.

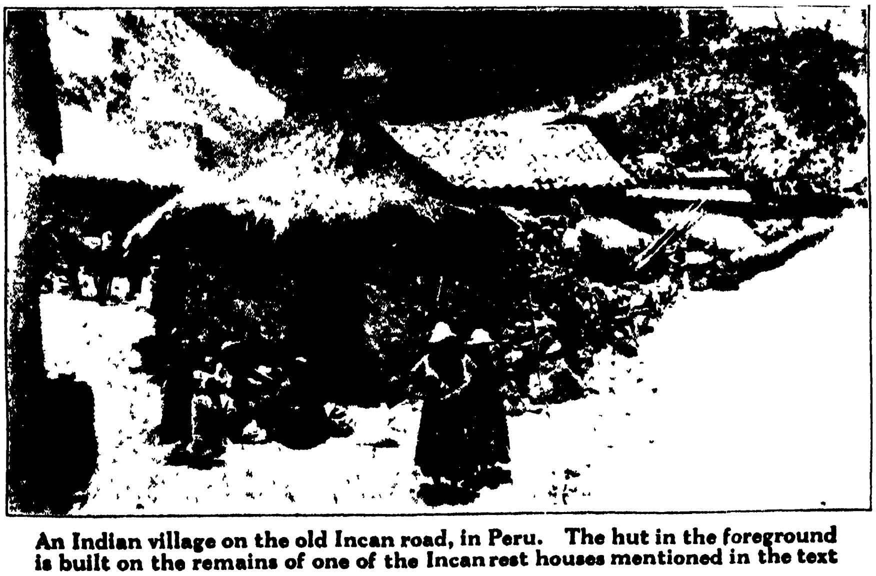
But the great highway that served the Incans so well in times of peace and war, the international road that connected the far-flung limits of their Empire, proved of inestimable value to their enemies as well. Over the Incan road the mail-clad Dons marched to Cuzco and their wanton destruction of the Incan civilization. And over it, following it across the vast Atacama desert, marched Pedro de Valdivia to his bloody conquest of Chile.

A wonderful, a fascinating, a romantic tale could this old highway tell if it could speak. A tale of riches, of conquests, of murder, bloodshed, and pillage such as the world has seldom seen equaled. If ghosts walk, then, surely, there should be an endless procession of ghosts over this highway.

A bit of the old road where it passes through an Indian village in Peru. Note that it is well paved

BUT even ghosts would find much of it hard going. Long stretches of it have completely disappeared. Many of the bridges have long since rotted and fallen away. Retaining walls have crumbled, letting the road disintegrate. Landslides have bodily destroyed miles of it, and modern roads and railways have cut through it. Still, portions remain in as good condition as ever. Llama trains still plod along it and patter over suspension bridges whose cables were stretched from shore to shore in Incan days. Portions of it also have been improved and incorporated in the splendid system of motor highways being pushed energetically forward. No country in South America has progressed so rapidly in its road work as has Peru. More roads is the watchword, the slogan, of that nation and the system of roads completed is remarkable.

If ever the proposed International Highway reaches South America, we may be sure that Peru will be ready and waiting to do her part of it, if indeed it is not completed through the land of the Incas long before it extends southward to the Peruvian boundary. Unquestionably, much of the great International Highway, where it crosses Peruvian territory, will be laid over the same bed, through the same tunnels made by the forgotten, prehistoric, mysterious pre-Incans. The time may yet come when one may drive a motor car from New York to Lima, or even to Valparaiso.



An Indian village on the old Incan road, in Peru. The hut in the foreground is built on the remains of one of the Incan rest houses mentioned in the text

The Difference Between

The Majority of the Discoveries of Practical the Scientist's Penchant for Prying Into

By F. K. RICHTMYER
*Professor of Physics,
Cornell University*

"TWEEDLE-DEE and Tweedle-dum agreed to have a battle,
For Tweedle-dum said Tweedle-dee had spoiled his nice new rattle."

Louis Carroll, in his famous Alice in Wonderland, has immortalized these celebrated characters and has given a very real meaning to the popular statement that, "the difference between Tweedle-dum and Tweedle-dee is something so trivial as to be entirely unworthy of further notice." When, however, we come to consider the way, if at all, in which this famous phrase is applicable to scientific research, either pure or applied, we realize that the phrase loses much of its popular meaning. Indeed, a glance over the history of physical sciences shows that, so far from being unimportant, "the difference between Tweedle-dum and Tweedle-dee," when carefully observed, has been responsible for a very large number of the striking advances which have taken place in science during the past four or five centuries.

Without discussing this matter in a general way, let us proceed at once to examine certain well known instances in which "the difference between Tweedle-dum and Tweedle-dee" has played an all-important rôle.

WE go back in history to the days of Copernicus, a younger contemporary of Columbus. You will recall that Copernicus, after making a thorough study of the apparent motion of the planets through the heavens, came to the conclusion that the Ptolomaic system of the universe was entirely wrong and that the heliocentric theory proposed by the Greek Aristarchus 15 centuries before was the more nearly correct. According to this latter theory, the planets—Mercury, Venus, Earth, Mars and the others—revolve around the sun in circular orbits. Perhaps the one good reason why Copernicus decided that the orbits were circular was that there was no good reason to suppose them anything else.

Then came the all-important question: What makes the planets move around the sun? The question was not to be answered for many decades, but in the meantime two astronomers made very substantial contributions to the subject. Tycho, the Dane, in the days before telescopes and with only a "sight-tube" containing cross hairs—a telescope without lenses—observed very carefully the positions of the various planets in their apparent motion among the stars. In particular, he made very careful measurements of the planet Mars. A young associate of Tycho was the astronomer Kepler. He was, as we would say today, a theorist and made very careful studies of Tycho's observations on the positions of the planet Mars at various times of the year. He noted that the motion of the planet, as determined from the very careful observations of Tycho, did not quite coincide with the hypothesis of Copernicus that the planets moved in circles. At certain times the planet Mars was not quite in the position which it should be were its orbit circular, the difference being some eight minutes of arc, or roughly one fourth of the apparent angular diameter of the sun. The difference between this predicted position, based on the supposition of a circular orbit, and the observed position was not very much—much less than "the difference between Tweedle-dee and Tweedle-dum." Kepler, however, knew that on the one hand the observations of Tycho could not be in error by even so small an amount as eight minutes of arc and on the other, that his own computations must be correct. *When observation and theory disagree, ever so slightly, theory must be modified.* The orbit of the planet Mars could not be a circle. After much long and tedious computation, Kepler hit upon the happy solution that the orbit of the planet is an ellipse with the sun at one of the foci of the ellipse.

Even so, however, the difference between the two paths, the apparent circular and the actual elliptical, was not very much but it was enough to play a very important rôle in subsequent developments. For, a century later, the fact that the orbits of the planets around the sun are ellipses gave to that great genius Newton, one of the strongest arguments in support of the now famous "inverse square law" of gravitation, a law which every school boy knows by heart and which states, "*Every* particle of matter in the universe attracts every other particle of matter in the universe with a force . . . inversely proportional to the square of the distance between the two particles."

WE who are concerned primarily with physical science, have come to take this law of gravitation for granted. It is an important law applicable in many branches of science—astronomy, physics, chemistry, and so on. But we sometimes forget the even greater philosophical importance of the discovery of this law. Newton saw its terrestrial operation in the falling of the apple. He saw its operation in the solar system in answer to the question: "What keeps the planets in their orbits?" And astronomers came to regard the law as applicable to the most distant stellar universes. For the first time in the history of the world, man came, with the announcement of this law of gravitation, to realize that at least in this one particular there is a common natural law extending and operating throughout the entire universe, a law which governs the motions of terrestrial objects, planets, and stars alike.

Without doubt, we are in large measure indebted for this law to the careful work of Kepler and Tycho in observing *and then interpreting* this small "difference between Tweedle-dee and Tweedle-dum," out of which difference grew the far-reaching law of gravitation as propounded in quantitative form by Newton.

WE pass over something more than a century and come down to about 1825, when many of the best known scientists of Europe were attempting to answer the question which that genius, Michael Faraday, put to himself: Is it possible to "convert magnetism into electricity"? A few years before this, in 1819, Oersted, the Danish scientist, had accidentally found that a magnetic field is produced by an electric current flowing through a wire; or, in the rather loose language of the time, electricity was itself "converted into magnetism."

Numerous observers were attempting the converse: namely, making an electric current by means of a magnetic field. In spite of numerous attempts, by 1830 most scientists had given up the problem as hopeless.

In the summer of 1831, Faraday was working in his laboratory at the Royal Institution of London in one more attempt to solve the problem. He had a hollow helix of many turns of wire, the ends of which were connected to a crude galvanometer; that is, a device for measuring an electric current. Into this helix he was going to introduce a bar magnet, hoping that the presence of the bar magnet would cause a current to flow continuously through the wire of which the helix was made. When, however, he tried the experiment the galvanometer showed no deflection when the magnet was in place.

Tweedle-Dum and Tweedle-Dee

Value to the World Have Been the Result of "Little Things" of Apparent Unimportance

He noted, however, that when the magnet was thrust into place in the helix, there was a very slight, hardly noticeable, motion of his galvanometer; and that when he removed the magnet from the helix there was again a similar slight motion. This slight motion was not what he was seeking and it was exceedingly minute—let us say only 1 percent of "the difference between Tweedle-dee and Tweedle-dum." But Faraday had never heard the couplet at the beginning of this article and to his discerning mind every bit of evidence, however, slight, must be taken into account. He, therefore, made a further study of these slight motions.

In an incredibly short time Faraday had shown that these slight motions of his galvanometer indicated unmistakably "the conversion of magnetism into electricity"; and after further study he evolved the physical laws governing the process.

Some four decades later students of applied science began to understand that these laws had a very important practical bearing. An understanding of them led to the development of electric motors and dynamos for the production of electric power. Out of this development in the seventies grew our whole electrical age of today. Within a year or two we shall be celebrating the centenary of Faraday's discovery and perhaps some eulogizer of this great scientist will again point out the very important fact that "The difference between Tweedle-dee and Tweedle-dum" has played a very important part in making this the age of electricity and thereby in revolutionizing present-day civilization.

WHY should Michelson have spent so much time in making new and ever more accurate measurements of the velocity of light? The discovery of argon answers the question.

In 1894 two English scientists, Rayleigh and Ramsay, were interested in making a more precise measurement of the density of the well-known gas nitrogen. Whatever may have been their reasons for making this measurement, we might at the present time look upon their motives as based upon idle curiosity, if you will. When, however, they had determined this density with a higher precision than had ever been attained before, they observed that samples of nitrogen from different sources and prepared under different conditions had slightly different densities. They may have been suspicious of the unimportance of the "difference between Tweedle-dum and Tweedle-dee," and they sought to find the reason for the difference in densities of these samples of nitrogen. The result of this search was most profound. They discovered that the reason for the differences was due to the presence, in varying amounts, of the hitherto unknown gas argon, which, because of its chemical inactivity, had previously escaped detection although it makes up well toward 1 percent of the atmosphere.

Now, one might say that a gas which makes no chemical compounds, can not be seen or smelt, and makes up only 1 percent of the atmosphere is of no great importance. Nevertheless, the discovery of this gas soon led to the discovery of other similar gases and today we recognize a whole series of them, known as the inert gases: helium, neon, argon, krypton, and xenon. These gases are somewhat similar to each other but differ from each other in certain of their physical properties.

Seldom has a discovery been productive of greater results. In recent years we read much about the question of atomic structure; how the atom is like a miniature solar system with a nucleus containing a positive charge of electricity around which are swarming electrons in various states of orbital motion. It is not too much to say that the starting point of the various modern theories of atomic structure is to be found in certain properties possessed by this series of inert gases and it is doubtful whether, had those gases not been discovered, our concept of the atom would be anything like as definite as it is now.

But we need not confine our discussion of the importance of the discovery of argon to matters pertaining to physics and chemistry. We all know that helium is being used as a much safer gas than hydrogen in dirigible balloons; that neon, as well as some of the other gases, is finding important practical uses in electric signs; and that argon has played a very important rôle in the development of the gas-filled incandescent lamp (by its introduction, the efficiency of artificial light sources was almost doubled). Those who are interested, may compute the value in dollars and cents of this particular use of argon and thereby can place a monetary value on "the difference between Tweedle-dee and Tweedle-dum."

But why elaborate the thought further? Everyone will be able to call to mind numerous illustrations of the fact that minute differences such as those which have been mentioned, play a very fundamental rôle in all branches of human activity. Indeed, machines have been taught to recognize "the difference between Tweedle-dum and Tweedle-dee." For example, one of the important revolutions in modern machinery has been the introduction of the ball bearing and the roller bearing. The very success of the ball bearing depends upon making steel spheres which differ from each other in diameter by not more than one ten-thousandth of an inch. Two Fords—at least as they leave the factory—are much more nearly alike than the proverbial "two peas." The ability thus to duplicate parts is one of the striking successes of our modern industrial life.

ONE catch-phrase definition of a genius states that, "a genius is one who has an infinite capacity for taking pains." Like many another of its kind, this definition contains just enough of truth to make it somewhat dangerous. Many a man has an infinite capacity for taking pains, but he will never be a genius.

I propose an alternative definition: A genius is a man who can observe *and interpret* "the difference between Tweedle-dee and Tweedle-dum." And let us emphasize "interpret." It was not so much Kepler's discovery of the slight discrepancy between theory and observation in the motion of Mars; it was his ability to interpret this difference that brought him fame. It is quite probable that other investigators before Faraday had observed similar "kicks" in galvanometers, but Faraday regarded the minute disturbances as worthy of further study. Had Ramsay and Rayleigh been content merely to point out that different samples of nitrogen seemed to have different density, we might have waited a long time for the discovery of the noble gases, with their important uses in both science and industry.

A very large part of present-day research in science depends on devising instruments and methods for making more and more accurate measurements, for observing minute differences hitherto beyond detection. So frequently has it happened that new phenomena have been discovered when such measurements have become possible, that it is now almost an axiom that "a new discovery is to be found in the next decimal place." Michelson's motive in repeating, each time more precisely, his determination of the velocity of light thus is obvious.

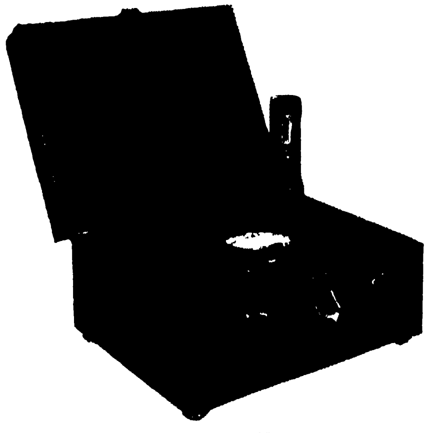
The Scientific American Digest

Conducted by F. D. McHugh

Direct-Reading Light Intensity Meter

ONE of the latest uses of the photoelectric cell is in connection with a meter to measure light intensity, now being built at Newark by the Westinghouse Electric and Manufacturing Company.

This cell, in various special constructions, has already found many uses in industry and is finding new ones almost continually. The present meter, embodying a new application of the photoelectric cell, should render unnecessary the question in a picture studio, "Is it light enough in here?" A photographer need not wonder whether the north light today is as strong as it was yesterday, for the meter always gives the same values for the same intensities. Used in connection with a printing frame it makes possible accurate adjustment of lights when certain special printing is to be done.



The photoelectric cell is an important part of this light meter

The instrument is complete in a case 12 1/2 by 10 by 6 5/16 inches, and consists of a special cell of broad response covering the visible spectrum, in series with the smallest size "B" battery and a microammeter calibrated directly in foot-candles. The light "pickup" or cell, something like a radio tube in appearance, is connected to the meter by a cord and may be moved about a six-foot radius outside the case. Normally directional, so that light from given points may be studied, it may be made non-directional as well.

The sensitivity of the meter is pronounced; used in tests at a motion picture studio, it showed the change in illumination of an actor's face when he lighted a cigarette.

Further suggestion of its value is seen in the studio where Mazda lamps are used with panchromatic film, in color photography where intensity of special colors is desirable, and in cinema houses to measure the screen illumination It may also be used to determine illumination in factories.

The New Digest

WITH the express purpose of improving the quality—as to selection, preparation, and appearance—of the material heretofore presented in SCIENTIFIC AMERICAN following the major articles, we inaugurate this month what might aptly be called a *super* SCIENTIFIC AMERICAN Digest. This enlarged section of the magazine will contain items formerly segregated and published under various specific heads, but their authorship will remain as before

Professor Alexander Klemin, in charge of the Daniel Guggenheim School of Aeronautics and Associate Editor of SCIENTIFIC AMERICAN; A. E Buchanan, Jr., Lehigh University, Corresponding Editor of SCIENTIFIC AMERICAN, and Morris Fishbein, M. D., Editor of the *Journal of the American Medical Association* and of *Hygeia*, and Corresponding Editor of SCIENTIFIC AMERICAN, will be responsible for the articles, signed by their initials, in their respective fields of aviation, chemistry, and medical science.

Fireproof Houses in France

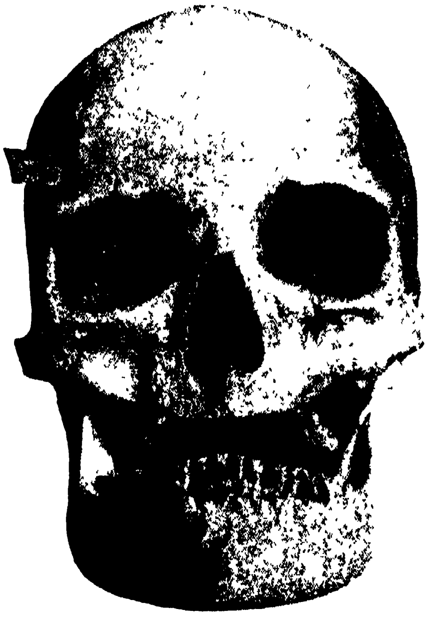
DWELLINGS of fireproof wood are being erected in France by a German concern as part of the reparation payment. Each month 100 five-room houses of this type are being erected at a fixed price of 1500 dollars each.—*Engineering News-Record.*

Arrow Point Injuries

ALTHOUGH the stone arrow-points used by prehistoric Indians are fairly common, yet it is rarely that they are found imbedded in human skulls or other bones. Collectors of Indian relics regard such a find as is pictured on this page as a great prize. Numerous instances of such finds are known among the Indians of the eastern and middle North America, but the one shown here is the first to be recorded from the southwest. It was found on San Nicolas Island, one of the channel islands off the coast of California. The skull was associated with another cranium containing a small, black obsidian point. The present case shows the point firmly fixed in the right temple where its situation shows that a large artery inside the head was cut, and the Indian died of cerebral hemorrhage.

Angleworm Big as Snake

IF you happen to be in the Philippine mountains some day, and see an angleworm as big as a small snake, colored bright blue with pale yellow spots and bandings, don't blame it on something you may have eaten (or drunk) in the last village. It's real, and it's there, although it is a zoological rarity. Dr. M. Michaelsen, of Hamburg, Germany, has just reported to the *Philippine Journal of Science* on specimens collected in Luzon some time ago and forwarded to him by a fellow-countryman, W. Schultze, formerly an entomologist at the Bureau of Science in Manila. The specimens, when living, were over a foot in length and nearly an inch in



A relatively rare find: An Indian skull retaining the arrow head which killed the Indian ages ago

greatest diameter. They are of a species new to science and have been named *Pheretima ophioides*.—*Science Service*.

Chemical Warfare Turns to Peaceful Victories

WHILE the chief duty of the United States Chemical Warfare Service is military, it has made numerous contributions to chemical science and industry in peace time. The widespread activities and accomplishments of this branch of the service are described by Lt. Robert E. Sadtler in a recent issue of *Chemical and Metallurgical Engineering*.

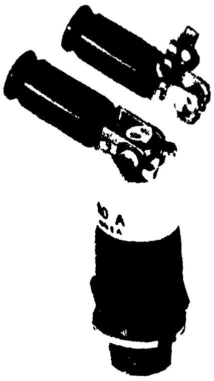
"Among the more important of these," says Lt. Sadtler, "is the development of compounds that will destroy the boll weevil more effectively than the calcium arsenate generally used; it (the Chemical Warfare Service) has demonstrated the use of tear gas in controlling mobs; it has developed gas masks for protection against industrial poisoning and ammonia fumes, and for the use of the public health service in its work of fumigating buildings. It also has assisted the shipping industry by three commercially valuable developments: toxic ship-bottom paints, protection of marine piling, and a safer and more effective method of ship fumigation."

"Anti-fouling paint, according to the estimate of competent authorities, will save the shipping industry from 125,000,000 to 150,000,000 dollars annually in reduced fuel and maintenance costs. The need of a poisonous paint for the exterior of hulls of ocean-going vessels is due to the accumulation of marine organisms, which increases fuel consumption and reduces the ship's working time by the amount spent in dry dock to clean the bottom. Barnacles are the principal marine organism attaching themselves to the ship's bottom. Not only commercial but naval vessels are affected by this growth."

Another interesting discovery made by the Chemical Warfare Service is that of the use of tear gas in controlling crowds and individuals. The effectiveness of this method in comparison with the old one of subduing the mob by the free use of bullets has been demonstrated frequently. A simple tear gas, chloracetophenone, in harmless, non-explosive tear-gas grenades, may be used effectually without permanently injuring anyone who may encounter it. This tear gas is a non-poison in the concentrations obtainable in the open air, and yet is effective even with one part of tear gas to three million parts of air. Its only reaction is to cause smarting of the eyes and the stimulation of the lachrymal gland causing a copious flow of tears.

Still another service which the Chemical Warfare Service has rendered to peace-time America is the development of various kinds of gas masks as protection against the deadly gases employed in many industries, and the detailed study of methods to prevent the fatalities resulting from other forms of poison. Since all of these poisons have at one time or another been brought to the attention of the Service as possible chemical warfare agents, the Service has necessarily made a close study of them and of methods of protection against them, and has been able to offer freely to industry the knowledge thus gained.—*A.E.B.*

Attacking the boll weevil from the air. Dusting cotton with chemicals



Two views of the new locking terminal for engine spark plug cables

A Locking Cable Terminal

THE accompanying photograph shows an interesting locking spark-plug cable terminal which has been approved by the Army Air Corps for airplane use. Powerful phosphor bronze jaws of this new terminal make firm contact with the spark plug. Then the contact is locked by a hinged bale that swings down across the end of the terminal. Violent air maneuvers, rough landings, sudden propeller blasts, engine vibration, or bumpy roads cannot loosen its firm grip. Yet, in service, the terminal may be removed as quickly as the ordinary kind.—*A. K.*

Scientific Research on Bricklaying

AN interesting example of collaboration between scientist and artisan is found in the broad scientific study of bricklaying recently inaugurated by Mellon Institute of Industrial Research and the Eastern Face Brick Manufacturers' Association. The experiments are being carried out by Dr. F. O. Anderegg, Senior Industrial Fellow of the Institute's Multiple Industrial Fellowship on Portland Cement, and his assistants, architects, building contractors, and masons are aiding the work

Above is shown the group of experimental brick walls that has been built on the grounds of the Mellon Institute. *At right*, an assistant makes use of the strain gage, sensitive to 0.002 inch, for measuring shrinkage

Friendly enemies exchanging reminiscences. Major George A. Vaughan, Jr., second American ace now actively engaged in the aircraft industry, and Captain Franz Carl Schlieff, former war pilot of the German air force. Major Vaughan was credited with 13 enemy planes during the war while Captain Schlieff accounted for 22 before the British shot him down on the Somme. Here he lost his left hand in the crash

by contributing opinions and advice based upon experience.

So many varying factors are involved in the construction of a brick wall that it has been necessary to limit the experimental study to combinations of variables representing the probable range of practical application. Hundreds of thousands of experiments would be required if all possible combinations were to be studied. For this reason the research program has been under discussion for a considerable period of time, and the actual investigation was begun only when a satisfactory plan had been elaborated. Up to the present time some several hundred experimental walls or panels have been erected.

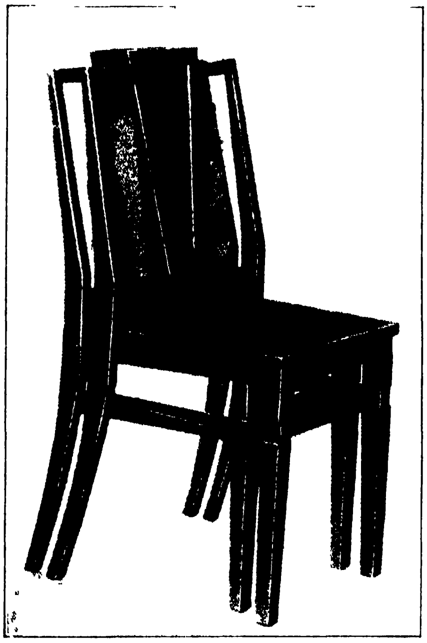
In brief, the investigation will cover certain aspects of all the factors involved in bricklaying. The most obvious points of attack are studies of the characteristics of different kinds of brick and mortar. Problems of special appeal to the practical man are those concerned with different methods of backing and with differences in workmanship. The design of walls and their relative elasticity are subjects which will be of considerable interest to contractors and architects.

Brick and mortar problems under investigation include the absorption and surface characteristics of brick, and differences in mortars due to varying the cementing materials, sand, and pigments. Properties of the mortars which are being studied carefully are workability, compressive and transverse strength, absorption and permeability, shrinkage, durability, staining and efflorescence, and elasticity. Information is being collected to determine whether the 10 percent of lime often specified by architects or the 25 percent or more usually employed by brick masons gives better all-around results.

The problems in backing include a study of hollow tile of different sizes, of brick, of cinder or concrete block, of brick tile, and of metal or other lath on steel frame. Variations in workmanship are most apparent in regard to tapping, pointing, and the filling of head-joints. The first mentioned subject is being studied, not only in regard to the effect of excessive downward tapping into place, but also in regard to plumbing both before and after initial set.

Nested Rigid Chairs Easily Stored

SINCE the time of the Pharaohs of ancient Egypt, there has been but little, if any, improvement in folding chairs. The same scissors-like legs that were used on chairs found in tombs of the Pharaohs are still used in making chairs that are collapsible for storing purposes, for ease in moving them in numbers, and so forth. And they are still as roundly sworn at for pinching fingers and tearing clothes as we assume they were in those olden days.



Two chairs of the type recently invented. They telescope one into the other for storage purposes

A patent has recently been granted, however, to Mr. Louis Dellert, of Brooklyn, New York, on a chair of conventional appearance but of novel design and construction. These chairs are made of sturdy pressed metal, and although they are rigid and non-collapsible, they effectively serve the purpose of folding chairs since they telescope one into the other.

All chairs of a set made according to this design are identical in all respects. Telescoping is possible because the seat frame is open in the rear and the sides of the seat frame, which is formed of metal, converge toward the front legs while the rear legs are securely mounted at the rear of the seat frame on the outer side. The thin metal seat slopes slightly forward. Any number of the chairs may, therefore, be nested, each additional one occupying only two or three inches more space.

They may be made in any period style, may have arms if desirable, and their seats and backs may be upholstered by means of thin removable cushions which may be stored between the backs when chairs are nested. A chair of this new type is well adapted for use in homes, banquet halls, or other places requiring strong, durable, attractive chairs that can be easily stored when not in use.

Tractor Efficiency on the Farm

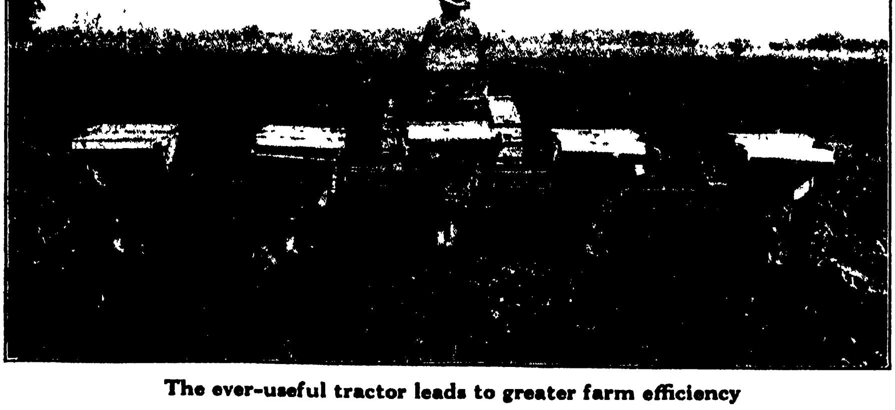
AS the horse is gradually supplanted by the tractor, the American farmer evidences a rapidly developing native ingenuity in the use of this modern time-saving aid to greater efficiency and profits.

On this page we show a tractor of the articulated tread type, equipped with five planters for fertilizing and planting four rows of corn and one row of peanuts. The planters are attached to the beam with a flexible hitch that allows a free up-and-down movement but prevents side movement. Three-inch spacing on the beams allows for any desired variation in the row width.

Chemical Prevents "Fatigue" of Rubber

EVERYONE knows that a piece of rubber can be stretched to several times its original length and will return almost completely to its original form as soon as the force is released. However, when rubber is stretched, released, and stretched again hundreds of thousands of times, it undergoes a form of deterioration which, for lack of a better name, we call "fatigue." When ordinary rubber "gets tired" it cracks; witness, for example, the cracks that develop on a pair of rubber boots where they are folded.

Rubber chemists of E. I. DuPont de

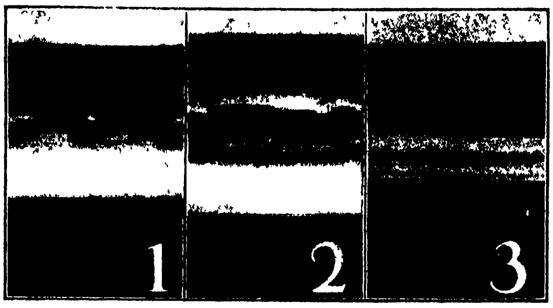


The ever-useful tractor leads to greater farm efficiency

Nemours Company have discovered that a very small amount of certain organic chemicals, introduced into the rubber before vulcanization, prevent "that tired feeling" and the resultant cracks in the rubber. The remarkable action of these chemicals, marketed under the name "Neozone" is described by E. R. Bridgewater in a recent issue of the *DuPont Magazine*. Referring to the use of Neozone in tires, he says:

"Carbon black made from natural gas is used by practically all tire manufacturers to toughen the tread rubber, thereby making it more resistant to abrasion. Most manufacturers use approximately two parts of carbon black to five parts of crude rubber, in high-grade tire treads. Greater amounts would be used if it were not for the fact that when more of this black pigment is used, there is a tendency for the rubber to crack at the points where it undergoes the most severe flexing when the car is in motion. It has been found that when small amounts of Neozone are added to the tread formula, considerably greater quantities of carbon black can be used without causing the rubber to crack at the points of flexing."

Many other rubber products, such as parts for hydraulic brakes, rubber belts for transmitting power, rubber wire-insulation, and many rubber articles whose purpose is to absorb shocks and vibration, have been improved in this manner.—*A. E. B.*



No Neozone is in sample No. 1 which shows the effect of bending a piece of rubber around a small pulley 1,500,000 times. Number 2 is identical and has gone through the same tests. Number 3 is identical except that it contains 1 percent of Neozone. It has undergone the test 3,750,000 times without cracking

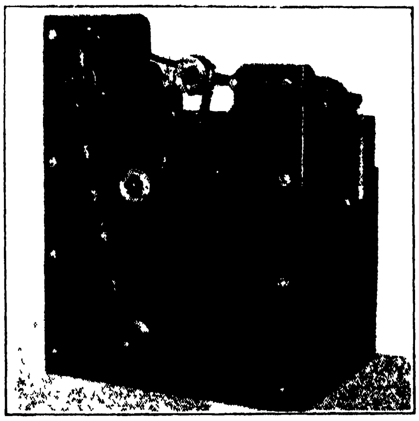
A Compass Turn-Table

SERIOUS errors in the aircraft compass often occur owing to the magnetic fields of the airplane's steel parts. The process of compensation is termed swinging the compass. For "swinging the compass," Army flying fields are equipped with circular concrete platforms. The platforms are placed not less than 100 yards from any steel structure, such as a hangar. Starting with the magnetic north, radii are laid out every 30 degrees. A dolly is used to elevate the tail so that the airplane is in approximately flying position with the engine running. The airplane is headed to various points of the true compass and deviations are noted and corrected by special compensating magnets, until the errors are reduced to a minimum. A table of corrections is then compiled. A useful wrinkle for expediting this process has been devised at the Croydon Airport in London. A special turn-table is provided on which the airplane is placed. It can then be swung to various directions in a fraction of the time required when the airplane is slowly turned by man power. The turn-table is easily turned by one man.—*A. K.*

At the Croydon Airport, a turn-table for "swinging the compass"

X rays and the Tonsils

THERE are various methods of controlling enlarged tonsils they may be removed by surgery; they may be destroyed by heat through an electric cautery or through electric heat, or they may be X rayed. As far back as 1913 it was suggested that X rays be used for the control of enlarged and infected tonsils, and since that time numerous papers have been written as to the effects of X rays on these tissues.



The flexing machine developed by the DuPont laboratories for fatiguing rubber. The weight at the right regulates the tension on the V-shaped sample "belt" of rubber

In the last quarter century hundreds of thousands of people have had their tonsils removed and it is now generally understood that removal of the tonsils is advisable in the presence of infection or of extreme enlargement. However, there is also considerable conservatism concerning the removal of apparently normal tonsils.

In St. Luke's Hospital, New York, Dr. Leila Charlton Knox has given special attention to the possibility of treating tonsils with X rays. She does not advise the use of X rays in children, particularly those with rheumatic symptoms. She does feel, however, that X rays provide a useful method in all cases in which operation is not advisable because of some secondary complication, particularly heart disease. Neither do X rays seem to be indicated in cases in which there is acute infection or a complicating disease such as diphtheria or scarlet fever.

X rays seem to be useful in the control of the secondary growth of lymphoid tissue in the form of stumps after the tonsils have been removed surgically. The method is also useful in elderly people who are troubled with chronic or repeated sore throats.—*M. F.*

Man Linked With Ground Sloth

WHILE the part of this magazine containing the article "The Mystery of Gypsum Cave," by Dr. M. R. Harrington of the Southwest Museum (page 34) was in press, the following telegram was received:

"Have found what seems to be the campfire of our sloth hunters: a patch of real charcoal under a layer of unbroken sloth dung capped by more than seven feet of undisturbed strata in the topmost of which are found Basketmaker and early Pueblo artifacts. This find to my mind establishes beyond question the association of man and the sloth.— M. R. Harrington."

Dr. Harrington's beliefs, as expressed in his article, apparently have been vindicated.

Carbon Remover

IT is a well-known fact that if a gasoline engine of the poppet valve type can be kept relatively free of carbon, the intervals between necessary removals of the cylinder head can be increased greatly. In the article "Your 1930 Car," published in our January 1930 issue, we mentioned a product of the Alemite Corporation, called Carbosolve, which has been installed as standard equipment on Chrysler cars.

This carbon removal system is now available for use on all cars, having recently appeared on the market in "kit" form. Essentially, it involves the use of a valve permanently mounted on the dash, and with a connection to the center of the intake manifold. The valve is so arranged that a can of the special carbon-removing liquid can be attached when it is desired to treat the explosion chambers. The makers recommend that this be done every 500 miles.

When the device is to be used, a can of

Leslie L. Smith of the N. A. T., exhibiting the airplane "overshoe"

the liquid is attached to the valve, the motor is warmed up to running temperature, and the valve knob is pulled out and the motor shut off simultaneously. The liquid is sucked out of the can and is equally distributed to the cylinders. The engine is then allowed to stand undisturbed for at least three hours, or overnight. It is then started and the carbon, loosened by the action of the liquid, is blown out with the exhaust.

Airplane Overshoes

DR. WILLIAM C. GEER'S "airplane overshoes," developed with the aid of a subvention from the Daniel Guggenheim Fund for the Promotion of Aeronautics and with the co-operation of N.A.T. and the B. F. Goodrich Company, give promise of conquering one of the most serious hazards of flying.

The adhesion of ice to metal - polished aluminum for example—is high. The adhesion of ice to other substances varies greatly, and to some it is remarkably low. In previous attempts to solve the problem, the surface of the airplane wing has been covered with oil. The oils used have generally become viscous and sticky at their freezing temperatures, and moreover the wind forces have scrubbed off the layers of oil.

Profiting by these early mistakes, Dr. Geer selected a group of oils the freezing points of which fall below 20 degrees Fahrenheit, and the boiling points of which are high. Such oils would possess mobility at ice-forming temperatures and would be non-drying over long periods of time.

The second difficulty was to prevent the scrubbing off of the oil by the wind. To render this scrubbing off impossible, the oils were absorbed into thin sheets of vulcanized rubber, which can absorb a large volume of oil. To avoid the weakening and deteriorating effects of oil upon rubber, the effects of over 100 oils and oil mixtures were investigated. Finally an oil mixture was found which gave to the vulcanized rubber practically zero adhesion to ice and which left its physical properties unaltered. Moreover, the rubber thus treated showed the property of exuding oil at the freezing temperature. During the course of the intensive research work conducted in connection with this problem, it was found that the volume of ice formed on an untreated rubber sheet is somewhat less than upon other substances.

There then remained the problem of removing ice should this be formed despite the oil impregnation. Ice formed even upon a zero adhesion surface does not remove itself. It shapes itself perfectly to the wing and at the leading edge the low pressure over the wing helps to keep it on. To meet this third difficulty, Dr. Geer invented a simple mechanical device. This took the form of a light-weight thin rubber "overshoe," or pneumatic nose, for the leading edge, with a fabric backing for strength. In the leading edge of this overshoe was placed an air tube strengthened with extensible fabric. This inner tube was connected to a pump, either motor or hand driven. The tube lay flat when collapsed and so altered the curvature of the wing very little. If ice forms in spite of the impregnated rubber, the pilot turns the air into the tube, thus slightly expanding it. This moves the ice and breaks the vacuum. The only precaution to be observed when flying under ice-forming condition is that the pilot should "break the ice" when the layer is still thin These overshoes are designed to be applied only when bad weather is expected, just like the overshoes of our everyday life.

In a test run in Cleveland in March, an overshoe was attached to a radio mast behind the cockpit. During the flight, ice formed to a thickness of about one half inch over the leading edge. A hand pump was used to expand the tube. When a pressure of two pounds per square inch was applied, the ice suddenly left the overshoes, flying off in chunks. Experiments on a wing and on a strut were similarly successful.

These experiments made in full flight are very encouraging. While pilots and operators always object to the addition of "gadgets" to aircraft, this gadget at least seems well worth while and we shall await further developments with keen interest.—*A. K.*

Measure the Speed of Dynamite Explosion

ONE of the most rapid chemical reactions known takes place when a stick of dynamite is detonated. It has been found that the detonation wave travels along a cartridge of dynamite at speeds as high as four miles a second. These speeds were measured at the Explosives Experiment Station of the U. S. Bureau of Mines, Bruceton, Pennsylvania, in connection with research and testing of mining explosives.

In one type of apparatus, known as the Nettegang recorder, the time elapsing between the breaking of two wires threaded through the explosive is recorded on a rapidly revolving smoked drum. In a method recently developed, the explosive is placed behind a narrow slot cut in a sheet of armor plate and the detonation process is photographed by its own light on a rapidly moving film. This method has the advantage that it records the speed of the detonation wave at every point along the column of explosive. It has been found that the speed of gelatin dynamites is affected by the degree of confinement under which the charge is fired. A charge of gelatin dynamite confined in a steel tube may detonate at a speed several thousand meters per second faster than a similar charge detonated in the open.

The explosion of a charge of dynamite is usually associated in our minds with a deafening concussion, but this is true only of dynamite fired in the open air. Charges of dynamite are exploded in massive steel bombs at the Pittsburgh Experiment Station of the Bureau of Mines, with only

Gelatin cartridge house, Mineral Springs plant of the DuPont company, showing earth barricades which serve as protection in case of explosions a metallic "click" to indicate that the charge has exploded and that pressures of 10,000 to 20,000 pounds per square inch have been produced inside the bomb. These bombs, known as Bichel gages, are used to measure the actual pressures produced by detonating explosives when fired in a borehole. The magnitude of the pressure is a measure of the ability of the explosive to do work.—*A. E. B.*

Trees Must Have Water

TREES need enormous quantities of water to keep them in a healthy condition, says the United States Department of Agriculture. An apple tree 30 years old gives off approximately a barrel of water a day in summer, and a good-sized birch tree gives off nearly two barrels of water on a hot day. A single oak tree is known to have given off into the air in the form of vapor more than 100 tons of water in a single growing season.

Dictaphone-radio hookup used in Oregon for recording market reports. As the prices are broadcast, they are" caught" on the machine's wax records

Chromium Poisoning

CHROMIUM is one of the chemical elements most commonly used in many industries. In etching zinc and aluminum plates in lithography, a mixture consisting of gum arabic, chromic acid and phosphoric acid, is applied to the plate with a brush or sponge and almost invariably comes in contact with the hands of the user. In another lithographing process, chromic acid or ammonium bichromate may be applied in other ways.

Drs. Carey P. McCord, Hobart G. Higgenbotham, and J. C. McGuire made a study of the hands of 37 workers, of whom 25 were lithographers and 12 were tanners. The application of the chromium mixture to the unbroken skin resulted in inflammation of the skin in 20 out of 25 cases among lithographers and in 10 out of 12 cases among tanners. The reactions included the inflammation of the skin and in some cases blisters.

It has for some time been realized that chromic acid or chromium compounds could bring about severe conditions when coming into contact with the broken skin, but it has been believed that chromic compounds would not attack the unbroken skin. Recent experiments indicate quite certainly that this belief is not supported by scientific evidence.

In studying eruptions of the skin it is important to keep in mind the occupation of the worker. Numerous irritants are employed in household work and in various trades. A condition called "photographer's eczema" is due to some of the chemicals used in developing pictures. Electrotypers and stereotypers and foundrymen get eruptions from the substances with which they work. Bleaching preparations of all sorts, hydrochloric acid and bichromate solutions used in the tanning trade, aniline dyes, shellac, and various plant extracts may cause irritations of the skin which must be studied carefully in order to be sure that the eruption comes from an irritant applied on the outside rather than from something in the blood developed inside the body.—*M. F.*

Spot-News via Telephone-Dictaphone

FROM the king's palace to the newspaper office may be a thousand miles, but the city editor of 1929 can look in on the coronation and be back at his desk in a few minutes. He can flash a question into the air and within 10 minutes have a reply from an explorer in the far jungle. And the wonders of news transmission are being perfected steadily to even higher efficiency. Already one of the marvels of this machine age, the modern newspaper is still concentrating effort on improving its speed in covering news. Within the past two years, the city editor has taken on another mechanical assistant. Dictaphone-telephone hook-ups are now being used to cut down the time and expense of transmitting news over long distances.

This new mechanical combination is now an accepted, regular means employed by leading Australian newspapers for reporting news from distant points. Long distance telephone lines are used at prearranged times by the newspaper's correspondent. Dictaphones with amplifier mouthpieces are attached to the telephones at the receiving end in the newspaper offices. The reporter speaks in an evenly timed voice, at the rate of 100 words a minute. An attendant "listens in" to the voice coming in over the wires, and when the machine's wax cylinder is filled, he signals the sender, who pauses while the cylinder is changed.

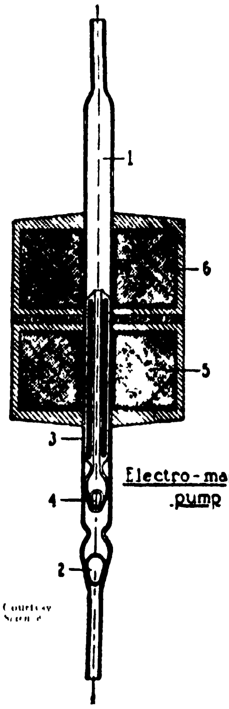
The cylinders containing the news material are transcribed by a corps of operators, with the regular transcribing machine and earphones. The copy is then passed directly to the sub-editor. Formerly news from distant correspondents had to be rewritten before it was turned over to the sub-editor for copy-reading, since the sentences were in choppy, abbreviated form for economical telegraphing.

The new method of news transmission, according to the *Rockhampton Bulletin*, has shortened the former all-night period for receiving news to about one hour daily. Because the correspondent can be certain of sending in all his material in one hour instead of three or four, he can now take time to organize his news carefully to present it in finished style, so that the work of the copy desk in handling his copy is reduced practically to punctuation and headline writing. The *Bulletin* estimates that the cost of receiving 15,000 words per week by telegraph, working six nights, was 30 pounds, or about 150 dollars. The cost of the same service by the new hook-up is 12 pounds a week.

In the United States, as might be expected, this new combination of machines to speed up news has been applied first to market reports and sports news. Dictaphone-radio hook-ups last fall kept Oregon poultry raisers in close touch with pre-Thanksgiving market news, so that they were enabled to sell to the best possible advantage. Their hook-up was made in the office of the county agent, where were recorded market reports broadcast during the working hours when it was impracticable for the farmer to listen in at his radio. The cylinders which caught the news from the loud speaker were tran-

A section of the new dynamite plant at Mineral Springs, near Birmingham, Alabama scribed into reports which reached the farmer within a few hours. This meant that he could plan his marketing from reports much less than a day old.

When the American derby took place last summer Clem McCarthy, nationally known turf authority, reported the racing classic minute by minute over the radio. A receiving set in the composing room of the *Chicago Herald and Examiner* was hooked up for recording, and as the derby progressed, the story of each race was recorded on dictation cylinders in the newspaper office within the minute that it took place hundreds of miles away. This method of reporting, used in connection with the Sharkey-Stribling fight in Florida, speeded up the news so that newsboys crying the outcome of the fight met the homeward bound fans.



Fluids passing through this pump make contact with glass only

Huge Week's Sales of Airplanes

SALES of airplanes, engines, and gliders amounting to three quarters of a million dollars in a single week is the record established at the New York Air Show, which closed May 10, according to the Aeronautical Chamber of Commerce of America, Inc., sponsors of the show. The authenticity of the sales reports was vouched for in signed statements filed by exhibitors at the show. More than 120,000 people are said to have passed through the doors of Madison Square Garden while the show was in progress—another high record.

Flying school operators reported their biggest sale of flying school courses during a single week as a result of contacts made at the air show. Furthermore, thousands, inspired by reports of the show and by the flight of a fleet of 140 Navy planes, a number of Army planes, and 77 commercial planes over the city, took their first airplane rides from several of the flying fields near the city during the week of the show.

The sponsors of the show announce that another gigantic show will be held in the city next year.

An Electromagnetic Pump

DURING the course of some investigations in the Laboratories of the Rockefeller Institute for Medical Research, it became necessary to devise a pump which could be used to circulate sterile fluid in a system free from any rubber, metal, oil, grease, or cement. To fulfill these requirements, a pump has been constructed entirely of glass, in which the motion of the piston is actuated by electromagnetic forces.

The diagram shows the pump in cross section. The pump cylinder (1) is a glass tube which has a carefully ground valve (2) at its lower end. The piston (3) consists of two tubes with a soft iron core fused between them. The lower end of the piston has a valve (4) which is identically the same as the cylinder valve (2). Both valves close by gravity. The pump cylinder is surrounded by a lower solenoid (5) and an upper solenoid (6). Both solenoids are hooked up in separate circuits. By means of a three-pole, automatic mercury switch actuated by a rocking device, the electric current flows through the solenoids periodically in such a way that they are switched on and off, one after the other, with an intermediate state in which both solenoids are magnetized for a short time. Thus, a magnetic field is created inside the solenoids. The center of this field travels up and down periodically.

The iron core inside of the piston is attracted into the center of the magnetic field. The piston moves up and down continually, like the plunger of any pump. The up-stroke of the piston opens the cylinder valve (2) and closes the piston valve (4), while the down-stroke closes the cylinder valve and opens the piston valve. By this means, any fluid can be circulated or transferred.

The pump has many practical applications, especially where it is necessary to maintain sterility. It can also be employed for blood, and for strong acids, alkalis, or other dangerous fluids.—Heinz Rosenberger, in *Science*.

A Marine Airport

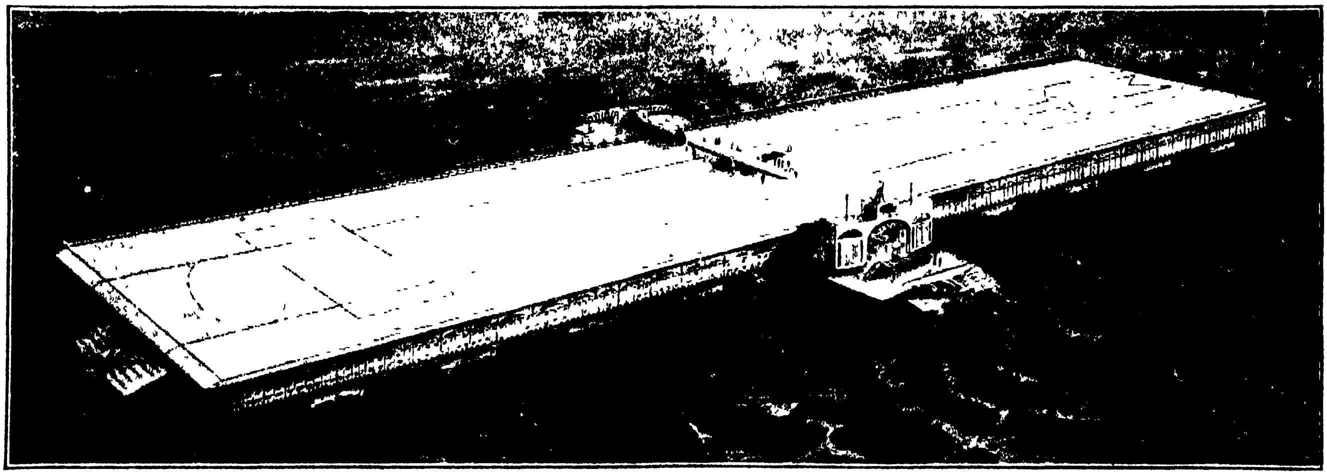
THE Engineering Service of the American Institute of Steel Construction has worked out a very interesting design of a floating marine airdrome for use near a big city. It was described in a recent issue of *Airports*.

Utilizing the experience of builders of steel railroad-car barges, the flotation principle has been applied to serve as the foundation for the drome. Although the structure weighs 7500 tons, its draft of water is but seven feet.

With this shallow draft the marine airdrome could be used near large cities, as for example in the waters of the upper bay of New York. It would then be comparatively near the center of the metropolitan area. The great problem of accessibility to large cities would be at least partially solved.

The top deck of the airdrome would have dimensions of 1000 by 200 feet. Since the airdrome could be so anchored as to head into the prevailing wind at any time, these dimensions would provide sufficient landing and get-away runs for all but the most heavily loaded aircraft. These dimensions would be greater than those available on the Navy's aircraft carriers. The deck would be entirely clear of obstructions. In the middle of each side there would be a wing bulging out about 25 feet for the convenience of passengers and visitors. The flood-lighting system would be such that the beam would be thrown into the wind or following the direction of the landing plane. The approaches for a mile or two in both directions would be illuminated by a series of lights that could easily be mounted on buoys 500 feet apart.

Aside from serving as floating elements,



Courtesy Airports

Drawing of the marine airport designed to be anchored in shallow water

the pontoons are to house the heat, light, and power machinery. To keep the decks clear and to hasten take-offs, two heavy-duty elevators are to connect the two decks of the airdrome. The lower or service deck is to have an area of approximately 180,000 square feet, with an overhead clearance of 21 feet. Across the middle of the service deck there is to be a terminal building providing every airport facility including a hotel, waiting rooms, restaurant, offices, and other facilities. At each end of the structure a wide terrace is to be provided which would connect with a seaplane float below. Seaplane or amphibian facilities would thus be provided.

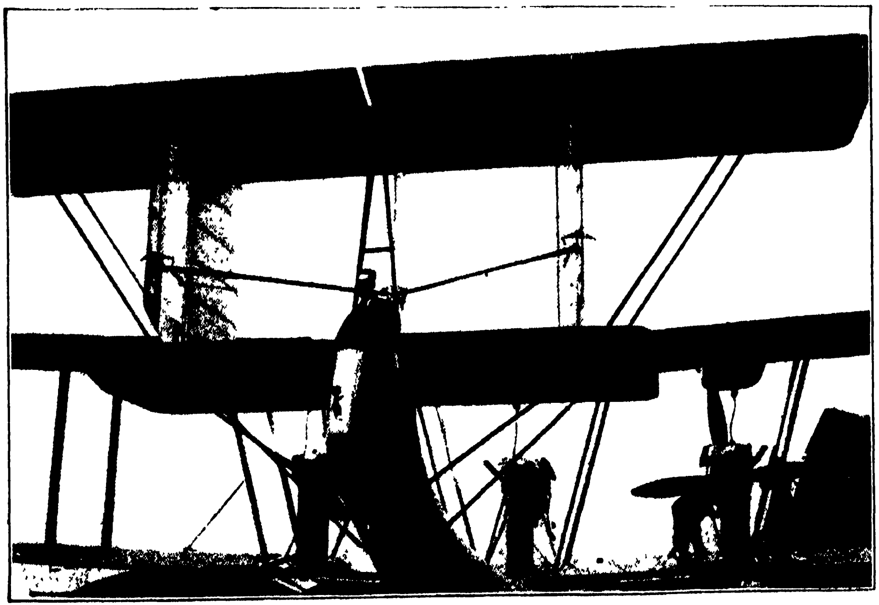
A novel and simple form of anchorage has been designed permitting a dual control, so that the airdrome can be headed into the wind at all times. The primary anchorage is arranged so that the structure will revolve within a radius of 600 feet.

While the marine airdome is still only in the "idea" stage, it seems feasible and plausible.—*A. K.*

Talkies for the Hard of Hearing

THE person who is hard of hearing has a most difficult existence, since he can not indulge in any form of entertainment or human activity in which the sense of hearing plays a prominent role. Recently a campaign has been undertaken in this country by the American Federation of Organizations for the Hard of Hearing to cause theaters, churches, music halls, and motion picture houses in which the talkies have replaced the silent pictures to equip some of the seats with plug-ins for hearing devices. Several theaters have already installed such plug-ins.

In the device installed in one London theater by L. E. Coussell, an engineer, a microphone is placed slightly in advance of and immediately below one of the loud speakers. There is a cable lead at the back of the screen which is taken from the microphone to a plug point on the stage, and further telephone cable is then connected with a special three-valve amplifier. A second line runs from the amplifier to a block of seats in the auditorium. This block is wired with armored cable and each seat hsa a telephone jack under the arm rest. The listening set consists of a single ear phone on a handle with a local volume control. The flexible cord of the ear phone terminates in a telephone plug, which lifts into the jack already mentioned. Each hearer can control the volume of sound to suit his own needs. The results were so satisfactory that similar equipment has been installed in other theaters.


Protecting the vulnerable point. A machine gun in the tail of a bomber

In this country the need of hearing devices is much greater and the campaign now being lead by Mrs. Louise Pelton of the Chicago League for the Hard of Hearing is tending toward the establishment of plug-ins. Already 25 out of 100 churches in Chicago are equipped and several motion picture houses are installing equipment.—*M. F.*

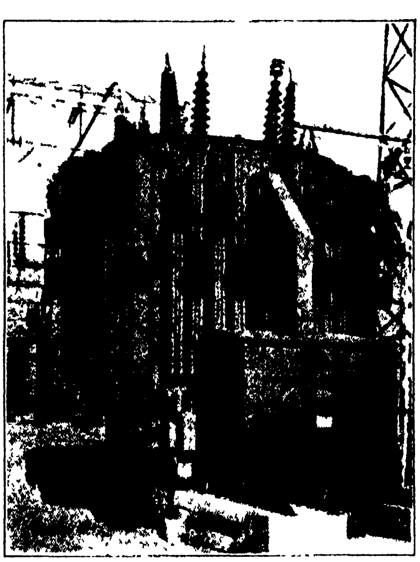
Cooling Transformers with Fans

A RECENT development in increasing the capacity or rating of a transformer involves the placing of fans about the radiators. The accompanying photograph shows one of a bank of three Westinghouse transformers installed at the Plymouth Meeting substation of the Philadelphia Electric Company. Each conical shaped projection houses a fan, or blower, which keeps a draft of air circulating through the radiators. The rating of this bank of transformers without the fans was 100,000 KVA, the capacity with fans as shown is 130,000—an increase of 30 percent.

A Gunner at the Tail

THE large reconnaissance flying boats of the American and British navies are airworthy and seaworthy craft, capable of cruising long distances without the support of surface vessels, and are well equipped and well armed. Nevertheless, a large flying boat with many guns may be no match in single combat with a small combat machine, because the latter is so maneuverable and so fast. The best protection for the large and less maneuverable craft is to be able to fire in every direction.

The Blackburn Company of England, has recently built a large all-metal boat, equipped with three Rolls Royce engines of over 600 horsepower each, in which an attempt has been made to give perfect fire range in the rear—where a large plane is most vulnerable—by installing a gunner's cockpit in the extreme end of the hull, aft of the tail surfaces. It is to be hoped that the gunner can easily make his way through the hull to a more central location. All the oscillations of the plane are so magnified at this distance from the center of gravity that even a hardened aviator might at times feel "squeamish.—*A. K.*


The conical projections on the side of this transformer each contain a cooling air fan or blower

To Destroy Poison Ivy

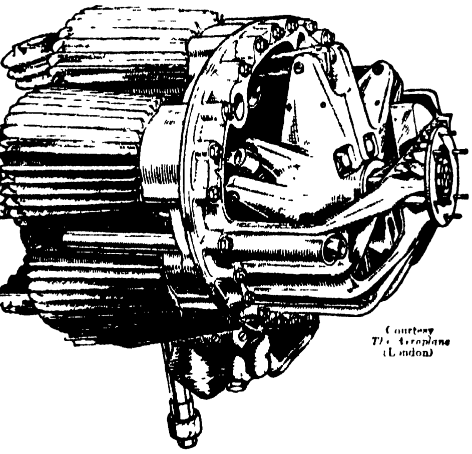
LOW-grade kerosene or crude oil, sprayed on the poison ivy vine, suffocates the plant tissues and causes destructive chemical action so that the plant dies. High-grade kerosene is not so good for it to volatilizes too rapidly. Best results are obtained in hot weather. If possible, it is also advisable to cut the stems near the ground and repeat the cutting frequently until the plants are starved. Through lack of foliage, the plant, once it has used up the food stored in the roots, cannot manufacture more food for re-growth.

Loss of Hair Attributed to Deficient Diet

IF your hair is falling out it may be a sign that your diet is deficient in Vitamin G, the latest addition to the recognized family of diet principles introduced to a recent meeting of the American Chemical Society by Professor H. C. Sherman of Columbia University. Although Vitamin G has been identified for only about one year, physiological chemists at Columbia have conducted elaborate experiments of the effects of its presence or absence in the diet of rats. In these animals the vitamin is directly connected with growth. Lack of it, said Dr. Sherman, may retard growth, stop it, or in extreme cases cause death. In some rats the shortage caused premature old age. Loss of hair is one of its most commonplace danger signals. Its lack is suspected as a cause of pellagra.

"The growth requirements of rats," he said, "presumably apply to other mammals also. Vitamin G must play a prominent part in any adequately comprehensive conception of food values from now on."

Still another member of the vitamin family is suspected to be hiding behind "G." Dr. Sherman called it the "new factor" stating that it, too, is important for growth, and that evidences of its presence have been detected by several other laboratories in addition to Columbia's. This new factor is abundant in milk and presumably in meat. Vitamin "G" is abundant in milk and leaves, such as spinach, kale, and cabbage. It appears moderately, Dr Sherman said, in meat and eggs —*A. E B.*


Courtesy *The Aeroplane* (London)

In this view of the Redrup axial engine for aircraft, the five-pointed star member which rotates on the Z crank (the special form of the crankshaft) may be seen at the right end. The cylinders lie parallel to the center-line of crankshaft rotation, as explained in the accompanying text

The Redrup Axial Engine

THE air-cooled engine of the star, or radial, type is always being criticized on the grounds that it impedes the pilot's vision because of its large over-all diameter and projecting cylinders, and because its head resistance is large. To make the engine more compact and to reduce the head resistance, the suggestion has often been made that the cylinders should be so arranged as to be parallel to the crankshaft, and quite near to the crankshaft center. The great difficulty in such an arrangement is the mechanical one of converting the reciprocating motion of the piston into the rotary motion of the crankshaft. The Redrup-Level axial engine, recently described in *The Aeroplane* (London), seems to offer an ingenious and successful solution of the difficulty, avoiding excessive rubbing velocities and highly-loaded bearing surfaces.

It can be seen from the drawings that the crankshaft, which lies along the axis of the engine, is carried by two roller-bearings and one ball-bearing. The crank-pin is one of the special features of the engine. Instead of being eccentric and parallel to the shaft, it is set at an angle and actually crosses the center-line of the crankshaft, and is called a Z crank.

On the Z crank is a five-pointed star-member, each point of which is attached to the connecting rods of the five cylinders through a neat form of universal joint The connecting rods carry a universal joint at their piston ends also. The star-member has two white metal bearings in which the Z crank revolves.

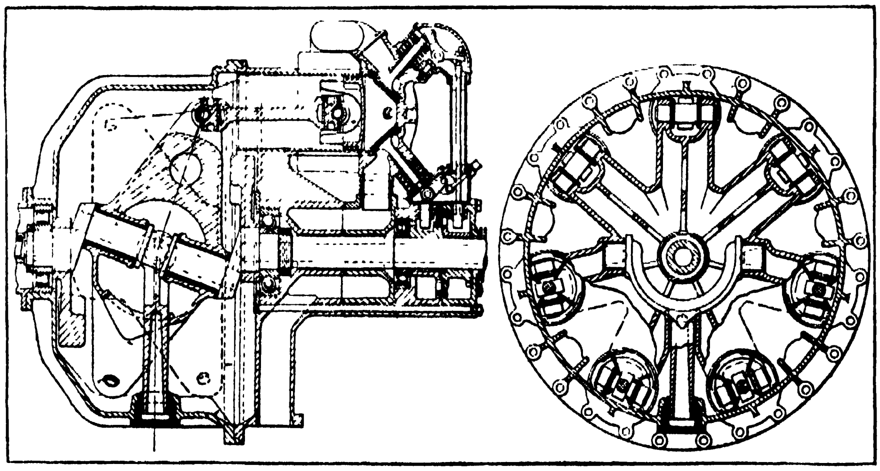
The easiest way to understand the motion of the star-member is to consider the instant when the top cylinder has just fired and the piston has completed half its down-stroke There is obviously a compression force along one side of that particular arm of the star, tending to push the crank down and around.

The star-member must be allowed to oscillate but be prevented from turning. This is accomplished by a stabilizing fork or torque rod. This rod has a fork at one end which is hinged to the inside of the star-member. The axis of the hinge passes through the middle of the crank-pin and is always at right angles to the axis of the pin as the torque-tube is carried in a self-aligning journal bearing at the bottom of the crankcase.

By this arrangement, the star-member is free to oscillate about the hinge of the fork, and, as the fork can twist in its journal bearing, the star-member can also twist about a vertical axis. Thus it can follow the wobbling motion caused by the rotation of the crankshaft and yet allow the full torque-reaction of the engine to be taken through the torque-rod to the crankcase.

There are three valves in each head, one exhaust and two inlet. They are of normal type and are operated by rocker-arms on the cylinder heads. These rockers are moved by push-rods with hardened steel balls at both ends.

The rods are operated by roller-ended tappets which are moved up and down by two-lobed cams running at one quarter engine-speed and driven in the direction reverse to that of the engine by epicyclic gearing off the crankshaft.


Courtesy *The Aeroplane* (London)

Cross-sectional views of the axial engine, side and front. At the left will be noted the manner in which the novel star member "rides" on the Z crank

In other respects the engine is normal in design.

The frontal area for the 60 horsepower engine has a diameter of only 18 inches. This opens many possibilities for use in a twin-engine machine, with engines mounted on the wings. The weight of the engine will be about 160 pounds or 2.6 pounds per horsepower.

The further development of the Redrup axial engine will be watched with considerable interest.—*A. K.*

Would "Perfume" Gas to Deter Suicides

"SOMEBODY is always taking the joy out of life," and now the chemist threatens to take the comfort out of dying, by mixing formalin with illuminating gas so that suicide by asphixiation will be less attractive. The interesting suggestion that formalin might be mixed with coal gas as a deterrent to suicides was made by Dr. F. J. Waldo, the London city coroner, recently. Dr. Waldo declared that the formalin admixture would make the would-be suicide's eyes water and perhaps also cause him or her to sneeze. As suicide is so often the result of a momentary brainstorm, the delay thus caused would probably give the would-be suicide time to think better of the idea.—*A. E. B.*

If You Ever Wash Dishes You've Wondered About This

EVEN editors have to wash the dishes occasionally, and it was in the performance of this domestic chore the other evening that we got to wondering what makes those silvery black marks on the china that simply will not wash off. By a queer coincidence, we picked up a *Technical News Bulletin* of the United States Bureau of Standards the next day, and learned that others have wondered about the same thing, and that the Bureau has investigated the phenomenon with interesting results.

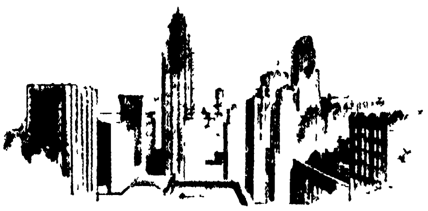
It is reported that when such objects as silver-plated knives are drawn across tableware, a mark results which can not be removed by washing. The bureau has carried on certain work which would seem to indicate that the trouble is caused by a slight, almost inappreciable roughening of the surface of the ware because of its being fired in the presence of gases from sulfur in the kiln.

This was shown to be the case by taking some pieces of ware from a manufacturer which did not show any cutlery marking and giving them a firing in an electric muffle into which measured amounts of sulfur dioxide were introduced. When as little as 0.0625 percent by volume of this

CONQUERING THE FOE ... *that turned back a Zeppelin*

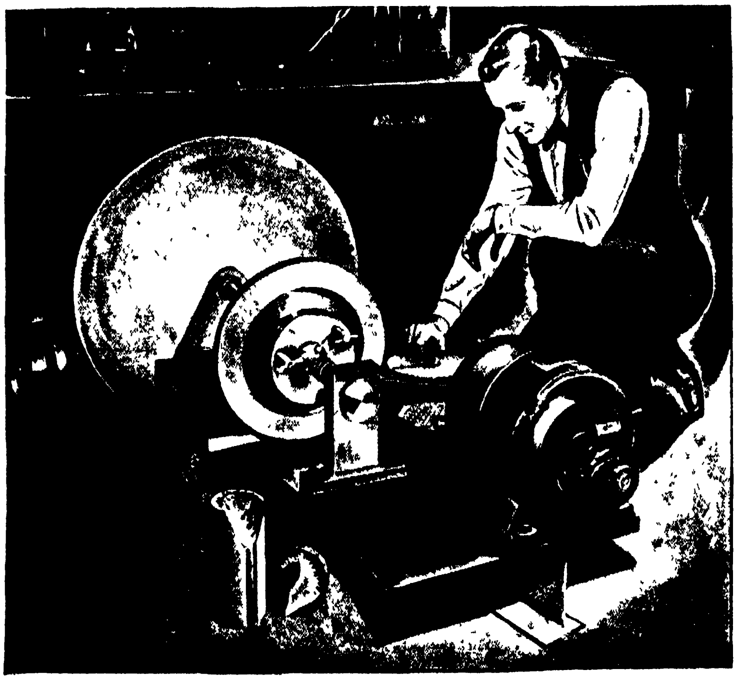
A giant Zeppelin not long ago started across the Atlantic. Hardly was it well under way, when, one by one, the drive shafts of four of its five engines cracked and went out of action. The great air ship turned back and landed—reaching its port just in time, as mechanics soon discovered, for the fifth shaft was then almost at the breaking point.

Vibration which turned back this huge Zeppelin is a foe to every modern high speed machine. In the Westinghouse research laboratories at East Pittsburgh vibration has been put on the stand to disclose its own secrets. Its ways have been charted. Its behavior has been reduced to mathematical formulas which engineers can now use in designing machinery to operate safely and reliably at the high speeds which modern industry demands.



Not only in electrical details of modern machinery, but in mechanical details as well, Westinghouse carries on its work of research and improvement—helping you to have more by making machines capable of doing more.

The results of Westinghouse research actively serve you in mines and factories, theaters, homes, stores, and offices—wherever the work or recreation of the modern world is carried on.

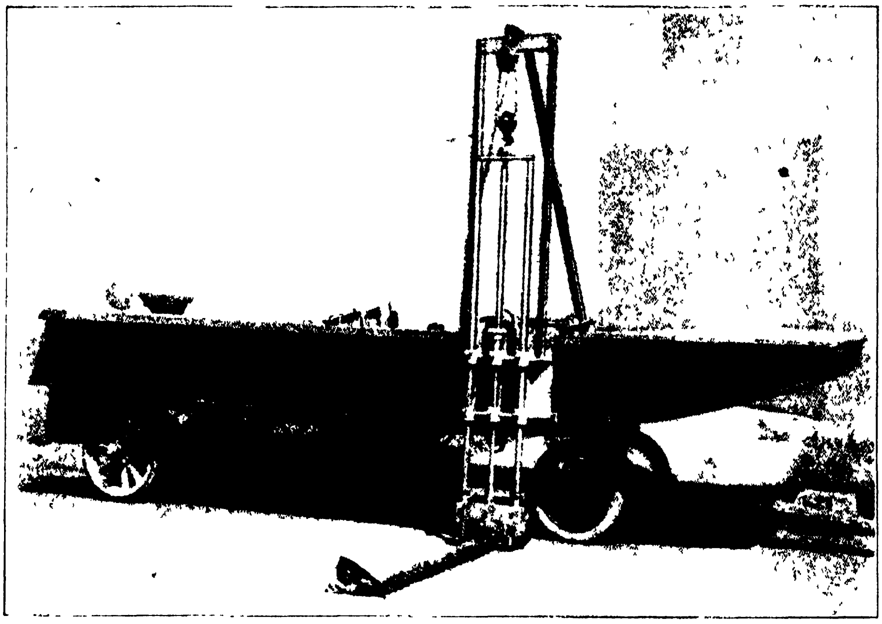


Tune in the Westinghouse Salute over WJZ and the coast-to-coast network, every Tuesday evening.

Westinghouse

gas was introduced into the muffle the ware, on removal, gave ready evidences of cutlery marking.

It was further found that on treating the ware, fired as described above, with solutions of ammonium acetate, lead sulfate was dissolved from the surface of the glaze.



The lily mower which cuts the stems of these plants under water. It consists of a boat (here shown on wheels) with an adjustable mower attachment

On the removal of this material by such a process as buffing, the ware no longer would mark. Samples of enameled iron similarly fired also developed a condition which resulted in cutlery marking. Commercial practices would seem to confirm the above result. One manufacturer, in substituting an electric muffle for firing his decorated ware, obtained a product that was no longer susceptible to cutlery marking. The fact, however, that this trouble was due to the formation of an extremely thin layer of lead sulfate seems not to have been noted previously.—*A. E. B.*

Steel Industry Consumes Most of Our Manganese

ABOUT 95 percent of the manganese consumed in the United States is used in the manufacture of steel, the principal base alloys being ferro-manganese and spiegeleisen, according to the United States Bureau of Mines. There is considerable manganese in many varieties of steel, including spring steels, plate steels, structural bar types, rail steels, and various steels used in the manufacture of wheels, tires, axles, armor plate, and other products of a similar nature.

Formerly manganese steels containing 1 to 1.5 percent manganese were classed as good-grade Bessemer steel, but recently they have been classified as alloy steels and have been put on the market under various trade names. Such steels have excellent tensile strength and ductility with high resistance to abrasion, and are used extensively in Caterpillar shoes, truck wheels, and other appliances where relatively low cost and high quality are required.

A manganese steel containing 12 to 14 percent manganese is used in castings for ball mills, pulverizing machinery, and to impact wear and because of its hardness. Manganese is also an important constituent of nickel and molybdenum steels. Molybdenum steels usually contain 0.2 to 0.4 percent molybdenum and 1 to 1.5 percent manganese. Nickel-manganese steel usually contains approximately 1 percent nickel, 1 to 1.5 percent manganese, and 0.3 to 0.4 percent carbon The nickel adds ductility and toughness but increases the cost.—*A. E. B.*

Underwater Lily Mower

THE problem of mowing a heavy growth of pond lilies from a 50-acre reservoir in Earlington, Kentucky, resulted in the ingenious "boat mower," shown in the accompanying illustration. The growth of lilies was satisfactorily eradicated with the machine shown and a knotty problem thus was solved.

The flat-bottom scow is driven by a 35 horsepower Universal motor, which operates the cutting mechanism as well as propels the boat. The flywheel of the engine was removed and replaced by a spur gear. Between the cutter bar and the motor were placed an automobile clutch and transmission gear so that the boat could be propelled without the action of the cutter, and also to permit different speeds without having to operate the cutter bar.

The cutter bar is adjustable for different depths of water and performs at varying depths of from 18 inches to 60 inches below the surface. The middle bar on the carriage is the driving shaft on which the bevel bar slides up and down to drive the shaft by means of a key which fits in a groove. The bottom shaft is connected to an eccentric and connecting rod which gives the necessary oscillating motion. The entire gearing was arranged to drive the cutter at a slightly slower speed than the normal speed of such a bar on an ordinary mowing machine. The cutting mechanism is raised and lowered by a differential pulley.

The strange craft has been christened "The Lily Nipper."

Page From This Magazine Does Duty as Wall Paper for 78 Years

THE following item was clipped from a recent issue of *The Arcata Union*, of Arcata, California:

"While tearing down an old wall in the Vassaide Building a few days ago, carpenter Collins came across a board with a piece of newspaper attached to it which had been doing duty as wallpaper. The fragment was a portion of the SCIENTIFIC AMERICAN dated 1852 and was put in use when wall paper was scarce in Arcata."

Portable Sound Movie

A DISTINCT innovation in the motion picture field a thoroughly practical portable equipment for the presentation of sound movies—was recently announced by the Bell and Howell Company. Amateur projectionists will be particularly interested to know that 16-millimeter films are exclusively used with this newly developed equipment.

The complete outfit consists of three small units which can be easily carried from place to place. Any Filmo projector

can be adapted for use in this equipment. A standard 16-inch phonograph record of the 33⅓ revolutions-per-minute type, is synchronized with the projected pictures. The projector, player unit, and a dynamic speaker each are contained in a separate case, and can be quickly set up and easily operated.

The Filmo projector and playing unit are driven by separate motors, each motor designed for its special purpose. The two units, the projector and the playing unit, are then coupled together mechanically by means of a flexible shaft so that positive synchronization is assured, regardless of the length of the picture or record.

Diesel Engined Ford Tri-motor Plane

SEVERAL airplane manufacturers are offering their planes equipped either with a gasoline motor or the Packard airplane Diesel engine, the purchaser to have his choice. Of these, according to *Barron's*, The Ford Motor Company, in its advertising pamphlets of the Ford tri-motor plane powered by Packard Diesel engines, says fuel consumption for each engine runs about 10 gallons an hour, which at nine cents a gallon brings total fuel cost to around 3 dollars an hour, a saving in fuel cost of more than 60 percent. Diesel engines decrease both cost and quantity of fuel necessary and use about 20 percent fewer gallons per horsepower than gasoline engines, it is pointed out.

Paper Mulches for Growing Plants

"ONE thing leads to another" may be a conversational platitude but it certainly describes the process by which one enterprising home gardener profited. A recent letter from Mr. B. K. Smith, of Newcastle, Indiana, states that he read the article "Farming Under Paper" in our August, 1928, issue and then during the summer of 1929 experimented in a small way with paper mulches. Inasmuch as his experiences may prove of benefit to others, we quote below a letter which he sent to the *Newcastle Courier:*

"We have worked out a method that can be used for garden mulch around the plants. Last year we were growing green beans. When the drought came, their leaves began to wilt and were doing no good. The first row we tried soaking the ground around them thoroughly in the evening, then taking the first or second section of the *Indianapolis News* or a whole *Newcastle Courier*, folding them to fit between the rows, thus making packs of eight to 12 or more sheets thick. We laid them close to the plants on each side of the row like shingles, only reverse, commencing at the top of the grade, so that when it rained the water would run under the packs instead of over and off. We soaked the papers thoroughly and put dirt, stones or bricks on the upper corners to prevent wind from blowing them away.

"The first week this row began to thrive and bloom. The other rows not so treated began to die.

"We also tried medium asphalt roofing cut in strips. This did not do so good as the paper packs but better than none. We find several sheets of thin paper to be better than one heavier or roofing. Also the water runs off the roofing instead of

(*Please turn to page* 68)

Leica
the versatile camera

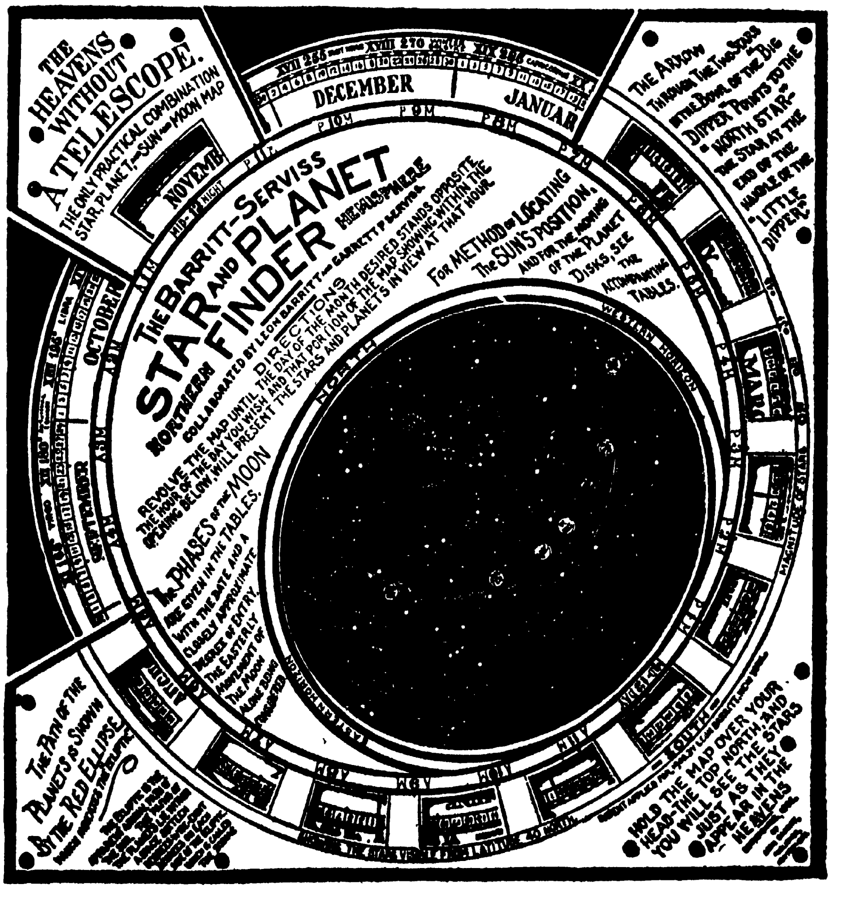
FOR travel pictures, action and sports pictures, portraits and panoramas, there is no camera like the Leica. Scientists, explorers, professional photographers and amateurs who recognize and demand superlative camera quality—all choose the Leica.

This unusual camera fits the vest pocket or purse, and its highly corrected lens insures clear, sharp negatives under the most adverse conditions of light and weather. A truly fine camera, inexpensive to operate. One roll of cinema film gives 36 pictures, and each picture is capable of perfect enlargement to 12 x 18 inches or more.

See the Leica demonstrated at your photographic supply dealer's or write for free catalog 1174. E. Leitz, Inc., Dept. S. A., 60 East 10th Street, New York, N. Y.

THE Leica

Fits the vest pocket or purse—weighs less than a pound


THE HEAVENS WITHOUT A TELESCOPE.
THE ONLY PRACTICAL COMBINATION STAR, PLANET, AND SUN AND MOON MAP
THE BARRITT-SERVISS STAR AND PLANET FINDER
NORTHERN HEMISPHERE
COLLABORATED BY LEON BARRITT AND GARRETT P. SERVISS
DIRECTIONS
REVOLVE THE MAP UNTIL THE HOUR OF THE DAY YOU WISH OPENING BELOW WILL PRESENT THE STARS AND PLANETS IN VIEW AT THAT HOUR. THE DAY OF THE MONTH DESIRED STANDS OPPOSITE AND THAT PORTION OF THE MAP SHOWING WITHIN THE
FOR METHOD OF LOCATING THE SUN'S POSITION, AND FOR THE MOVING OF THE PLANET DISKS, SEE THE ACCOMPANYING TABLES.
THE PHASES OF THE MOON ARE GIVEN IN THE TABLES, WITH THE DATE AND A CLOSELY APPROXIMATE DEGREE OF ENTRY. THE EASTERLY MOVEMENT OF THE MOON ALONG ECLIPTIC
THE ARROW THROUGH THE TWO STARS IN THE BOWL OF THE "BIG DIPPER" POINTS TO THE "NORTH STAR" THE STAR AT THE END OF THE HANDLE OF THE "LITTLE DIPPER"
THE PATH OF THE PLANETS IS SHOWN BY THE RED ELLIPSE
HOLD THE MAP OVER YOUR HEAD—THE TOP NORTH, AND YOU WILL SEE THE STARS JUST AS THEY APPEAR IN THE HEAVENS
DECEMBER
JANUARY
NOVEMBER
OCTOBER
SEPTEMBER
AUGUST
MARCH
NORTH
SOUTH
WESTERN HORIZON
EASTERN HORIZON
MAGNITUDE OF STARS

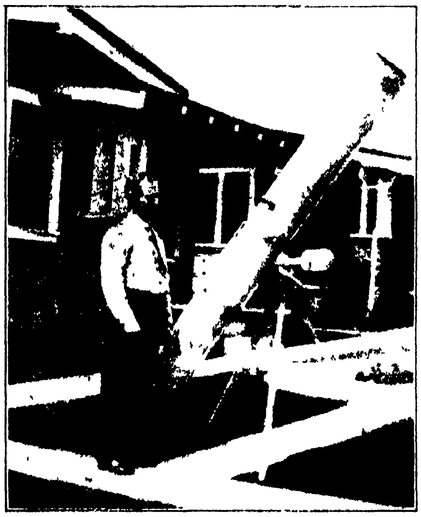
For Sale by SCIENTIFIC AMERICAN, *Price $5.10 Postpaid*

The Amateur Astronomer

A Monthly Department

THE amateur who aspires to make his own telescope is advised to begin on an instrument having a diameter of not more than six inches, as this is the most suitable size on which to get one's initial experience. Sets of materials, ready to use, may be had in this size for ten dollars, and the interesting work of grinding, polishing and figuring the mirrors should not occupy more than a dozen evenings.

When a worker has completed a six-inch telescope, though it should magnify from 50 to 200 diameters and be the equal of a refracting telescope four inches in diameter and costing 300 dollars or more—a real astronomical telescope—he is ready to tackle something larger. A 10-inch is about the ideal size for the average amateur ultimately to possess, representing a compromise between skill, pocketbook, and pipe dreams.



Nettell and his 10-inch

MR. RICHARD NETTELL, 155 North Boylston Street, Los Angeles, California, sends us a description and photograph of his 10-inch reflector. "I have made four or five telescopes before," he writes, "but this last effort of mine was made since I got the SCIENTIFIC AMERICAN instruction book 'Amateur Telescope Making.'

"The point I wanted to stress in my design was convenience and ease of observation and operation. The observer stands on the ground level, which is a great convenience for elderly or nervous people. The telescope is a tripod, take-down affair, as I have no room to keep it set up. The mirror is 10 inches in diameter, with a focal length of 130 inches. The tube is 11 inches in diameter and is eight feet long. At the upper end of the tube there is a three-inch flat, reflecting the rays back to the diagonal located opposite the eyepiece; making three reflecting surfaces in all. I appreciate the fact that by this design I lose some of the light, besides the loss through adding another reflecting surface, but I thought the convenience of standing on the ground more than compensated for that loss.

Lambert's four-inch

"The grinding and polishing were all done in the evenings, within three feet of our cook stove. The curve of the mirror, when I got through with polishing it, was as perfectly spherical as I could determine by the knife-edge shadow test, this with a room temperature drop of two degrees per hour. It showed in a slight degree the oblate spheroid form when the room temperature was even. All my previous mirrors had been more or less hyperbolical, and I wanted to avoid this if possible, so I estimated that the drop in temperature out-of-doors would give it the necessary parabolic form if I left it spherical

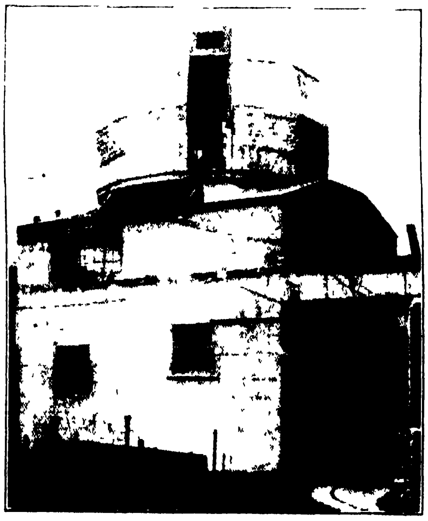
"In performance, my mirror, when testing it on distant bright terrestrial objects, gives fairly sharp definition when using a ⅕-inch focus eyepiece. That means a magnification of 650 diameters.

Staffa—Pyrex mirror

"The mounting is an equatorial, on a collapsible tripod, with a clock and weight drive. The pipe handle to carry it by, is also the finder."

Mr. Nettell evidently has succeeded in producing a good mirror despite proximity to a stove. Usually mirror making is done in the cellar, because there the temperature is most nearly uniform. Yet if the kitchen were also held uniform, and were about the same each night, the difficulty might not be great, for it is changing, not changed, temperature that causes trouble, as Ellison states (page 95, "Amateur Telescope Making"). One point to be considered is that ordinary pitch is too soft when used in a warm room. However, it may be boiled down to greater hardness, or resin may be mixed with it. At any rate, nothing succeeds like success, an adage which Mr. Nettell seems to have proved. He gets results from his telescope; it suits him; and that's that.

MR. ARTHUR W. LAMBERT, JR., Arcadia, Missouri, started on a four-inch mirror which he made from a disk of half-inch plate glass. His telescope is shown in one of the illustrations. Later he made a six-inch. He suggests that two mirrors should be started at the same time and "leap-frogged." He writes, "Let the worker get the first one ground and polished. Then mount it, silver it and begin to observe. He ought to get good results, at least intriguing and inspiring. Then let him try his hand on glass No. 2 and bring this to some kind of figure. He will improve on his first, then can switch mirrors, and can begin again on No. 1. By the time he has it again in the mount, he will know something more than he did, and can begin again on No. 2. This can go on indefinitely, until perfection is attained.



Pleasant View Observatory

"Another thing really surprised me. That was the real pleasures you can get from a poor glass. My first mirror, a four-inch made of windshield glass, is a very poor mirror. It brings a bright star to a sort of cock-eyed focus. Yet it splits double stars, sees the moon very well, and performs in a surprisingly good manner. I have it mounted in the telescope shown in the enclosed picture. With this little fellow I easily find the ring nebula in Lyra."

COMMERCIAL polished plate glass is the material almost universally used for the mirrors of reflectors less than 12 inches in aperture, but a finer material, though a more costly one, is Pyrex. It has the advantage of a low coefficient of expansion—about one third that of glass. Where the amateur is skilled enough to produce a nearly perfect figure he may use this material to good advantage. Mr. George Staffa, 32 Front Street, Schenectady, N. Y., used it, and reports as follows:

"The mirror was ground according to instructions in 'Amateur Telescope Making', from two 7½-inch by ¾-inch disks of Pyrex, to a focal length of 54 inches. The polishing was done on a lap made of resin, beeswax, and paraffin which, while hot, was impregnated with rouge. This took only a short time, as the grinding had been done very thoroughly; in fact, the whole process of polishing and figuring took only about four hours. The mirror was polished to the very edge, as is shown by a microscope. I experienced none of the troubles described in 'Amateur Telescope Making.'

"The figure appears just the same after standing for half an hour as it was right after removing from the lap. Very good results were obtained on Saturn; also Jupiter, on which the markings can be seen quite in detail. There are a number of other telescope enthusiasts in Schenectady who have made mirrors of Pyrex."

MR. GEORGE H. CHASE, 28 Washington Square, Newport, Rhode Island, has erected an observatory on the roof of his shop. He writes:

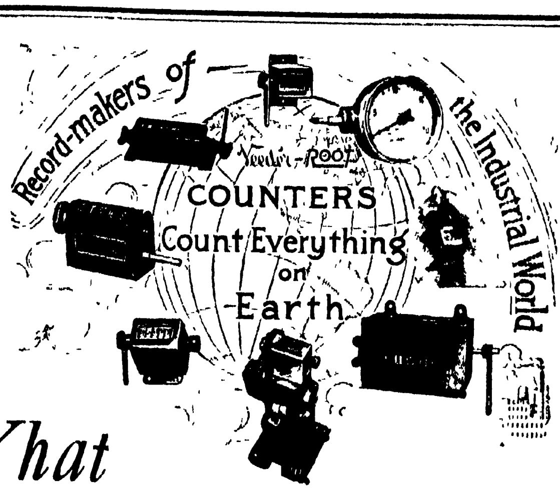
"The observatory shown in the photograph was built by Milton H. Chase and myself. The tower is built on top of a concrete workshop and is 14 feet in diameter. It rests on steel channels, and rolls around on eight wheels, being moved by an electric motor through a chain drive which passes around the outside of the tower.

"The electric motor control is on the post near the observer's seat. The framework of the tower is built of two-by-four joists and is covered with corrugated galvanized iron on the outside. The inside is covered with wall board. The present telescope is a six-inch, but provision has been made to take a 12-inch. This observatory is located at my home in Portsmouth, Rhode Island."

Speaking of amateurs' private observatories, *Popular Astronomy* (Northfield, Minnesota) began in January publishing an interesting series of descriptions of these, which is to run through the present year.

HOW about making a spectroheliograph? Since Dr. Hale contributed instructions for the job, ("A. T. M.," pages 180-202) a disappointingly small number have tackled it. One big obstacle is undoubtedly the cost of the grating, 125 dollars, but the remainder of the materials can be made by the amateur. In a recent letter Dr. Hale states, "You will be glad to know that spectrohelioscopes of the

(*Please turn to page* 70)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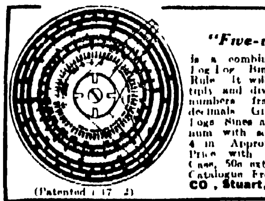

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The Scientific American Digest

(Continued from page 65)

under, as with the papers, and the packs will hold more moisture than the one sheet of roofing.

"We tried the paper packs on most of our garden last year on flowers, beets, onions, parsnips, cabbage, and tomatoes with good results. Probably we would have had better growth had we commenced using the papers before the ground dried out. As it was, however, the paper mulches proved their value.

"This year we expect to plant the seeds through the paper packs by using a sharp stick piercing the packs for plants to come through, first making a depression at the row so that the water will run to the plants."

Wood Impregnated with Metal

THERE has been developed during the last years by the German Institute for Steel Science in Duesseldorf a new procedure by which it has been made possible to fill the pores of wood with metal. The material which is thus produced combines to a certain degree the properties of metal as well as of wood. The new procedure is carried through by immersing wood in molten metal under pressure. The duration of this treatment and the temperature and pressure applied are of importance. All parts of the wood that are not filled by metal remain unchanged.

In a small trial plant, wood pieces 15 by 24 by 12 inches were thoroughly impregnated with metal. Infiltration may be limited to any desired depth. It has been found that the new material may be machined like ordinary wood. It is scarcely inflammable and does not enlarge its volume by taking up moisture. The appearance of the metallized wood is unique and it is expected that it will lend itself especially well to decorative purposes. It may also be suitable for lining journals and bearings, if a suitable metal is used for penetrating the wood. The new material was shown for the first time at a recent wood and timber exhibition in Berlin.—*A. E. B.*

New Solvents Eliminate Textile Problems

NUMEROUS textile problems have been greatly simplified or completely eliminated during the past year by the availability of certain of the new synthetic organic chemicals which formerly were not available on a commercial scale. Diethylene glycol has proven an almost ideal lubricant for wool spinning. Impregnation of the fiber with this chemical makes unnecessary the use of oils and as a consequence eliminates the costly operation of scouring for oil elimination after spinning. The glycol remains in the fibers of the spun yarn or fabric until the first treatment with either wash water or dye solution. At this point the glycol, which is water soluble, is removed without the necessity of another operation. New possibilities in the printing and dyeing of textiles have been made available by the use of Cellosolve and its derivatives as the medium for making solutions or pastes of dyes and colors. This group of solvents first developed for use in nitro-cellulose lacquers has thus found an extensive new application in textiles.—*A. E. B.*

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

ABRASIVE MATERIALS IN 1928, by Oliver Bowles. Grinding and polishing processes are of great importance. This pamphlet deals with the production of natural and artificial abrasives. *Superintendent of Public Documents, Washington, D. C.—5 cents (coin).*

STUDIES ON THE FALL ARMY WORM IN THE GULF COAST DISTRICT OF TEXAS (Technical Bulletin 138-T). Make application for this bulletin to the *Office of Information, Department of Agriculture, Washington, D. C.—Gratis.*

FOAMING OF MILK AND CREAM (Circular 108, United States Department of Agriculture) by C. S. Leete. Foaming often causes much loss of both product and labor and the present pamphlet is a practical treatise on the subject based on experiments. *Superintendent of Documents Washington, D. C.—5 cents (coin).*

ARCHITECTURAL ACOUSTICS (Circular of the Bureau of Standards No. 380) are not yet generally understood even by those who design auditoriums. In this circular the principles are stated and an example is worked out showing their practical application to the planning of a new auditorium. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

CHEMISTRY AND ANALYSIS OF THE PERMITTED COAL-TAR FOOD DYES (Department Bulletin No. 1390) by Joseph A. Ambler, W. F. Clarke, O. L. Evenson and H. Wales, deals with a subject in which there have been recent changes. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

AUTOMATIC LINE VOLTAGE REGULATION is a folder containing practical information on this subject as related to radio receiving set operation. *Clarostat Mfg. Co., 285-7 North Sixth Street, Brooklyn, N. Y.—Gratis.*

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THE SOCIAL PHILOSOPHY OF PENSIONS WITH A REVIEW OF EXISTING PENSION SYSTEMS FOR PROFESSIONAL GROUPS (Bulletin No. 25. The Carnegie Foundation for the Advancement of Teaching) by Henry S. Pritchett, President of the Carnegie Foundation. *The Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York City.—Gratis.*

FINLAND. AN ECONOMIC REVIEW (Trade Information Bulletin No. 681, Department of Commerce) deals with the most densely wooded country in Europe, where 80 percent of the population is rural, affording an expanding market for United States goods. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE MOTORIZATION OF NORTH AFRICA is the title of Trade Information Bulletin No. 689, by the Department of Commerce, dealing with the rapidly growing market for automotive products in North Africa. In 1929 it took nearly 2,000,000 dollars worth of American automotive products, an 85 percent increase over the previous year's figures. Any branch office of the Bureau of Foreign and Domestic Commerce, or ***Superintendent of Documents, Washington, D. C.—10 cents (coin).***

PULP-WOOD CROPS IN THE NORTHEAST (Leaflet No. 57, United States Department of Agriculture) by M Westveld. Illustrated. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

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CAESIUM, RUBIDIUM, AND LITHIUM, Information Circular 6215, details the history of discovery of these minor alkali metals, their various odd uses, alone and in alloys, their sources, and the markets for them. *United States Bureau of Mines, Department of Commerce, Washington, D. C.—Gratis.*

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SCIENTIFIC AMERICAN

The Amateur Astronomer

(*Continued from page 67*)

type shown in my article are already in use at Pomona College, California; the University of South Dakota; the University of Michigan; Yerkes Observatory; Ohio State University; Vassar College, the Royal Observatory at Greenwich; the Astrophysical Observatory at Arcetri, Florence; the American College at Beirut, Syria; the Government Observatory at Canberra, Australia; and the Observatory at Samoa. Others have been ordered for use in Chicago, England (2), and China, and two native Indians in Madras (one an amateur) are building outfits for themselves." Isn't it time more amateurs jumped into this interesting game? Thus far, five American amateurs have nibbled at it, and of these some are believed definitely to be "hooked." The blueprints cost only a dollar and a half. Reread Dr. Hale's chapters, also the *Astrophysical Journal* for December, 1929, and see whether these do not make you want a spectroheliosc ope. *A. G. I., Tel. Ed.*

Our Point of View

Analyzing the Naval Treaty

(*Continued from page 16*)

of the Japanese delegation was buttressed by three very solid factors, first, they attended a conference jointly arranged by Great Britain and the United States, and as guests were under no obligation to make the party a success; secondly, since 1922, in submarines, they had outbuilt both Great Britain and the United States and possessed more modern submarines than any other state at the Conference, nor had they weakened their position by advocating the abolition of submarines as weapons of war; thirdly, during the same period they had outbuilt the United States in cruisers, had built up to a 9 to 6 ratio in destroyers with Great Britain, and were fast attaining a 5 to 3 ratio with us in destroyers, the only category in which we had full strength.

The continuous and comprehensive naval program of Japan since 1922 has only one modern counterpart in time of peace, that of Germany prior to 1914, and it has been carried out despite financial difficulties and the destruction of Yokohama and part of Tokio by earthquakes. This vast naval program would be no proper concern of ours except for the fact that in Washington, in 1922, we scrapped our capital ships and agreed to limit the fortifications of our Far Eastern possessions when we believed the 5 to 3 ratio with Japan would be extended to all categories of ships. Now, by the provisions of the London treaty we concede parity to Japan in submarines, a 10 to 7 ratio in destroyers, and a 10 to 7 ratio in six-inch gun cruisers. As a climax, Japan expressly reserves the right, at the end of the treaty period, to reopen the question of further increasing her ratio of eight-inch gun cruisers to 10 to 7.

At present we have only a 5 to 3 ratio in capital ships because, although granted a 5 to 3 ratio in aircraft carriers, actually we have built only 66,000 tons of modern aircraft carriers against 61,270 tons for Japan, and we have authorized one more carrier of 13,800 tons while Japan is building one of 7600 tons. Thus, unless we accelerate our building program from now until 1936, we will be practically equal to Japan in modern aircraft carriers, and inferior in cruisers. We will have only a 10 to 7 ratio in destroyers, and all of Japan's destroyers will be modern post-war tonnage, while the bulk of ours were designed and hurriedly constructed during the World War to meet the German submarine menace.

Our position relative to Japan during the life of this treaty may be recapitulated: in capital ships we will have a 5 to 3 ratio; we will have a 10 to 7 *tonnage* ratio in destroyers, but our destroyers are all over 10 years old, while Japan's are all under 10 years, and one half are less than five years old, Japan has eight eight-inch gun cruisers in commission, we have one; by the end of 1931 we will have eight, Japan will then have 10; by the end of 1932 we will have 11 and Japan will have 12; by 1936 we will finally attain a 5 to 3 ratio in eight-inch gun cruisers. In six-inch gun cruisers, Japan today has 20 of 95,000 tons against our 10 of 70,500 tons. By the terms of the treaty if we build 18 eight-inch gun cruisers we can build six-inch gun cruisers only in the ratio of 10 to 7. Provided Congress acts promptly and we lay down four six-inch gun cruisers per year, it will be 1935, one year before the treaty expires, before we will attain a 10 to 7 ratio in six-inch gun cruisers. In modern aircraft carriers we have a scant margin on Japan at present, and unless we accelerate our building program during the life of the treaty, it will remain about 8 to 7. In modern submarines we are at present inferior to Japan and by the treaty she concedes us parity.

THUS, by resolutely carrying out her comprehensive building program between 1922 and 1930, Japan was able to send to the London Conference a delegation in a position to insist upon her demands. This position was rendered impregnable by the solid support the Japanese government and people gave their delegation. No group of Japanese pacifists weakened the arguments of their delegation with demands for naval reduction. As a result, Japan obtained practically every item in her demands, and yet following an ancient custom, the leader of her delegation, in his report to the Emperor, deplored his unworthy talents that so inadequately represented his country's case, while our delegation returned almost jubilant because the Japanese did not insist at this time on a 10 to 7 ratio in eight-inch gun cruisers.

The Japanese press states that Admiral Kato, Minister of Marine, strenuously opposed any concessions, and made at least one personal appeal to the Emperor to overrule the decision of the Government. This effort failed, but to placate the Navy Department, the Cabinet promised to find money for the following new projects:—

(a) An increase in the air force from 17 air battalions to 20 battalions.

(b) Building of some special service ships (types unspecified).

(c) Strengthening of fortifications.

(d) Increase of expenditures on account of the upkeep and repair of ships.

In short, the Japanese government will divert to other naval and military measures the money saved by the Conference.

The Japanese press also explains to the Japanese people that their government felt obliged to yield to Great Britain and the United States, lest the resulting estrangement between Japan and these two countries produce serious effects on Japan's international position, both politically and economically. One paper emphasizes the important fact that if the Conference failed and replacements of capital ships began next year under the terms of the Washington Treaty, Japan would have to find 75,000,000 dollars for building purposes which would necessitate still higher taxes. Finally the Foreign Office reminds the Japanese public that although under the compromise plan Japan's ratio was fixed at 62 percent, Japan's actual ratio up to 1936 would be 72 percent and that she had specifically reserved the right to restate her demands at the next conference.

It seems patent, therefore, that the small abatement Japan made in her total claims was due to her apprehension of the political and economic consequences if she offended both Great Britain and the United States, to her belief that a total failure of the conference would start battleship replacements in 1931 which she could not afford, and to the knowledge that during the life of the treaty she would actually have a 70 percent ratio in big cruisers. Having made this small concession it is significant that her government, to appease her Navy Department, authorized the Finance Minister to promise increased expenditures in the categories not limited It seems plain, therefore, that just as Japan diverted the money saved by the limitation of capital ships in 1922 into cruisers, destroyers and submarines, she now intends to devote the money saved by the limitation of the smaller categories into increasing her air force, building special-type vessels, expending more money on the upkeep of vessels already built, and, finally, increasing her fortifications. There is a little irony in this last item, for on the presumption of a 5-to-3 naval ratio we have promised not to increase any of our fortifications west of Honolulu.

WE can find no fault with Japan for nicely adjusting her foreign affairs and her naval strength, nor for supporting as large an army and navy as her finances will bear. Many Japanese still alive can remember their two wars with China and Russia whereby Japan established her present proud position in the Far East; it is natural they should prefer to trust their future to their own military strength rather than to international agreements. For this reason they patiently submit to severe taxation before they will reduce the efficiency of their armed force. We would remind Americans, however, that the 5-to-3 ratio with Japan exists only in capital ships, that opulence is not military strength, and commercial supremacy is no safe substitute for armies and navies.

On the credit side of the Conference, we place the removal of much of the previous friction between Great Britain and our country. We believe the great majority of the people of Great Britain have finally reconciled themselves to a naval parity with the United States and, while Americans properly regard that action as due our position and responsibilities as a world power, we should remember that for the first time since attaining sea supremacy, Great Britain has peacefully conceded another nation naval parity. Our relations with Great Britain during the next decade can be stabilized better on the basis of parity than on any other ratio. We have fought against her in two wars; we have been to the brink of war with her on at least two other occasions, during the World War we fought shoulder to shoulder with her; and we know better than any other nation that she can be a formidable foe or a faithful friend on land and sea. We have no conflicting interests with the British people that cannot be arbitrated and we have a common background of language, literature, and self-government. The manful manner in which they are meeting their post-war difficulties deserves all praise, and Americans do not enjoy haggling with them over cruisers or disputing over the technicalities of gun power.

Great Britain cannot ignore the European situation, the simple solution is for us to obtain parity upward to the minimum of her necessities and to cease our insistence that she reduce her building program to satisfy the wishes of our pacifists. This statesmanlike procedure would not only benefit our relations with Great Britain, but it would enable us to safeguard our world-wide commerce and meet our responsibilities in the Far East—and the few million dollars per year additional cost will be well spent.

REGARDLESS of its imperfections, the treaty should be ratified, unless the Senate discovers some technical clause that may need a clarifying reservation. The Congress and the Administration should then promptly inaugurate a six-year building program that will place our fleet on a parity with Great Britain and in its allowed ratio with Japan. Unless Congress does this, we are in the untenable position of demanding that other nations restrict their building programs because we are too penurious to spend money on our fleet. Now is an excellent time to begin building, for it will stimulate the steel and shipbuilding companies and give work to the numerous skilled artisans whose services are necessary to create a modern man-of-war and all its accessories. Practically every industry in the country would benefit.

We repeat that Congress should adopt a continuous and comprehensive naval program that will raise our fleet to the maximum treaty strength by 1936 and maintain it at that position without the frequent fluctuations that prevent economy and efficiency in our naval establishment; for, having settled their continental interior, Americans are returning to the ocean that nourished and sustained their seafaring ancestors until the forests were cleared and farming commenced. Shipbuilding was our first great industry; our merchantmen carried the commerce of Europe and Asia when our factories were still in our homes and our railways unbuilt. Our factories now produce more than we can consume; an extraordinarily efficient railway system deposits our enormous foreign trade on our wharves to load upon *foreign* merchantmen. We are taking measures to revive our merchant marine so that we will no longer be dependent upon foreign carriers, and we should not delay providing and maintaining a navy that will protect our citizens and our foreign trade in all parts of the world. This done, Americans can continue to go about their peaceful tasks, envying no other people their prosperity, avoiding foreign political entanglements, and developing friendly commercial ties with the whole world.

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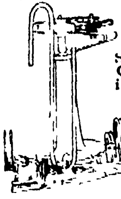

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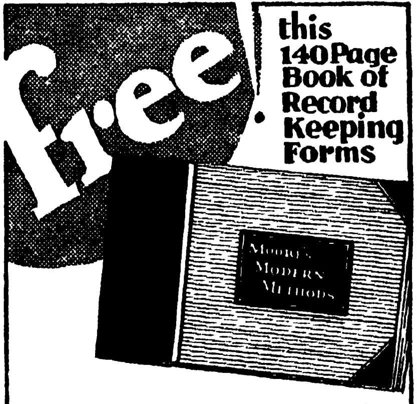

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Books Selected by the Editors

The Biological Basis of Human Nature *By H. S. Jennings, Prof. of Zoology, Johns Hopkins*

GENETICS—concerning the actual physical mechanism of inheritance as carried in the germ cells, male and female has reached brilliant levels. What concrete results may be brought about in the future when as a result of its findings eugenics and race control come into practice no one dares predict, but it seems certain to bring about some astounding changes for the better. The present book, by one of the foremost geneticists of the world (America leads in this branch of pure science) is a semi-popular exposition written for those who are willing to do some thinking. Dr. Jennings deserves a world of thanks for making available to the lay reader this subject, hitherto locked up in such abstruse form. Through his facile style of writing he has brought out its latent interest to an extent few would have thought possible. This book is not for the moron, but others—even those who are innocent of elementary biology —may expect to absorb its significant contents. $4.20 postpaid—*A. G. I.*

Generations of Adam *By. A. L. Wolbarst, M.D.*

"IT is the duty of a doctor to tell the public the truth about sex in so far as he knows it, regardless of where it may lead. Prudery, cant, and hypocrisy have brought us nowhere," writes the author. So he attacks the fallacy that sex is sin and emphasizes the difference between the biologic aspect of sex and the moral aspect as theology would like to have it. This he delineates with frank fearlessness, yet with delicacy and the broadminded humanitarianism demanded by civilized social sense. It is a work only for parents and educators and for those whose problems arise from adolescence. His explanations and advice are given informally, in a clean-cut way that cannot offend, yet with the dignity and force necessary to carry weight. $3.65 postpaid.

The Science of Biology—*By G. G. Scott, Prof. Biology, City College of N. Y.*

AN up-to-date revision of a standard text book suitable for independent reading by adults. It contains a systematic survey of the elements of the broad science of life and its known principles. To the reader who would be willing to devote an occasional hour to a systematic study of this book, current newspaper and magazine accounts of discoveries in medicine and biology would take on much deeper significance. It is also an excellent reference book. 633 pages, 390 illustrations. $3.90 postpaid—*A. G. I.*

Stuff—*By Pauline S. Berry, PhD., Asst. Prof. Chem. Penna. State College*

A SOLID book of 517 pages telling the story of materials in the service of man—a popular survey of chemistry, amply illustrated. In quite an ingenious way historical facts are woven into the thread of development, together with the personality of the accomplishment, giving a most humanistic tone which beguiles the reader. An unusual presentation. $5.20 postpaid.

Conquering the Air—*By Archibald Williams*

THIS fifth revised and rewritten edition is of importance because more of the history of foreign accomplishment is given than one finds in most of the popular aviation books published in this country. Detailed accounts of major efforts make an historical record that will be more valuable as time passes. Hence this book should be included in any aviation library. $2.20 postpaid.

The Science of Everyday Life—*By Van Buskirk and Smith*

THIS is a school book of the newer type which means it was designed to get its hold on the reader because of its inherent *interest*. The variety of scientific subjects dealt with is vast, and the illustrations so interesting that the reviewer found the book hard to put down. If anyone *knew* only what is in this book he would have a right to claim an unusual knowledge of all around elementary science, both pure and applied. A fine book to put into your boy's hand. It would hold his interest past bedtime—after which father will sit up with it past midnight. $1.75 postpaid—*A. G. I.*

The Use of the Microscope—*By John Belling, Cytologist, Carnegie Institution*

FROM this treatise the microscope worker may glean with comparatively little effort the experience technique, wrinkles, dodges, and shifts which an expert has acquired after a long career. If you do research with a microscope, especially in biology, this book will extend your arm. It is very practical and should be at the elbow of every microscopist. $4.20 postpaid—*A. G. I.*

Skyways *By William Mitchell, Genl., U. S. A. (Ret.)*

EVERYONE will concede the author to be one of the foremost authorities in the world on aviation from the standpoint of its practical aspects. Here he covers the technical features of aeronautics with a general view of its development throughout the world. Considerable space is given to a discussion of the physical conditions of modern flying, the difficulties, aids, differences in equipment, et cetera; in fact the bigger, broader aspects are handled in a way to satisfy many of the questionings which perturb the lay mind. It would be strange indeed that 30 years experience would not afford much valuable material which is not elsewhere duplicated. We predict this book will be digested by every student of aviation. $3.20 postpaid.

How to Fly an Airplane—*By Percival White*

IN this textbook for beginners, the author seeks without using technical formulas or abstruse physical explanations, to give the reasons why one should learn to fly, gives the fundamentals of plane construction, and merely touches on aerodynamics. It speaks direct to those who want to handle the controls themselves as well as to those desiring to become licensed pilots. The numerous illustrations are interesting and descriptive, the whole presentation being from an angle quite different from other books on the subject. $5.20 postpaid.

Dead Towns and Living Men—*By C. Leonard Woolley*

A FAMOUS archeologist presents intimate touches about digging at typical sites: how excavating gangs of natives are employed, bossed, and paid; how unruly small bosses are coped with; how local petty grafting officials are handled and their bluffs called. This group of narratives makes the reader sense the difficulties under which most archeological field work is carried out, and reveals what a keen insight into human nature the field archeologist must exercise in Egypt, Palestine, Italy, and so forth. The book answers the question so often asked and so seldom answered, "What is the actual every-day work of archeological excavation really like?" $2.15 postpaid—*A. G. I.*

From Recent Publications

JUMP—*By Don Glassman*

TALES of the Caterpillar Club with a chapter devoted to Lindbergh, its illustrious fourth degree member. Members of this club must qualify by a parachute jump from a disabled plane or balloon (exhibitions not counted). From War Department archives, from ancient records, from unpublished manuscripts, the author has assembled the entire history of the parachute. A complete description of parachute construction and the education of a parachutist is given, with a list of members of the Caterpillar Club as qualified. $3.20 postpaid.

MODERN LIGHTING—*By F. C. Caldwell, Prof. E. E., Ohio State Univ.*

THIS is the best technical though not too technical—new treatise we have seen which takes up artificial lighting from every angle. There are chapters on theory of light; good lighting (adequacy, glare, diffusion); types of lamps technically described; measurement of illumination; globes, shades, et cetera; design of lighting systems in buildings; industrial lighting for efficiency; lighting for all sorts of purposes—schools, residence, streets signals, signs, decorations; a chapter on light projection; and scientific treatment of other aspects of lighting too numerous to mention. It is a book suited both in scope and depth to the business man, industrial man, home owner, and general reader, any one of whom could claim after reading its 360 illustrated pages that he knew the elementary principles of good, efficient, scientific modern lighting. $4.45 postpaid—*A. G. I.*

TOWARD CIVILIZATION—*Edited by Charles A. Beard*

HEREIN the scientists and engineers, the makers and directors of machine progress, are given their day in court. This book follows another "Whither Mankind"—in which it was developed that western civilization, as distinguished from other cultures, is in reality a technological civilization resting at bottom on science and machinery. This thesis was discussed and developed mainly by specialists in the humanities—law, economics, and ethics. "Outsiders looking in" reported their findings and impressions. A group of prominent engineers in New York considered this a challenge to the whole profession; for are not technologists thinkers as well as doers? This group of "doers" sees at hand the promise of great advances for mankind, and is considering the drift of things and the nature of the readjustments for a better future. In the present volume we have "Insiders looking out." "Toward Civilization" is not concerned with history but with prospects, with work "in process." The result is a very significant volume, as a wider promise of co-operation and as a revelation of the engineering mind to the lay public. $3.20 postpaid *A. A. H.*

THE AWAKENING COLLEGE—*By Clarence Cook Little*

ONE might say that it was inevitable that Clarence Cook Little would write such a book as this, for he was a college president when he was still young enough to understand youth, its aims and ideals, *its individuality*. Formerly president of the University of Michigan, president of the University of Maine, and Assistant Dean of Harvard College, he has witnessed the rebellion of youth against "spoon-fed" facts, the discarding of outworn teaching methods—in fact all the momentous changes that have taken place in our colleges these past few years; and has treated the subject in a sympathetic style that is critical, sometimes dogmatic, yet always superbly analytical and readable. The influence of extra-curricula activities such as fraternities, athletics, religion, and even automobiles and liquor is discussed in this volume for parents and educators. $3.20 postpaid—*F. D. McH.*

IN SEARCH OF AMERICA *By Lucy Lockwood Hazard*

"WE all go forth to seek America. And in the seeking we create her. In the quality of our search shall be the nature of the America that we create." This quotation from Waldo Frank gives Professor Hazard an opportunity to measure up to the text with a very unusual book. It is divided into five parts: "Biography," "History," "Folk Song and Story," "Locality," and "Criticism." Each part is subdivided and under each are given admirable selections in prose and poetry bearing on the subject. Some of these selections are quite long—which is an excellent fault—and there are copious bibliographies. Primarily intended for college students, this book is a welcomed addition to the general library. It correlates the practice of composition with a study of American life by stimulating discussion on the provocative problems of today. There are several explanatory introductions. $3.90 postpaid *A. A. H.*

THE AMERICAN YEAR BOOK—*Albert B. Hart and William M. Schuyler, Editors*

THIS work of 904 pages, including a most complete index, represents the combined effort of 196 contributors with the co-operation of representatives from 46 societies, covering the entire field of science and the humanities. It is a record of events and progress during 1929. No more adequate or authoritative treatment can be found in this type of reference it is essential to every cultural library. Arranged in seven parts to include historical, American government, governmental functions, economics and business, social conditions and aims, science, and the humanities, a clear-cut, succinct review is given under each heading by an authoritative writer. A superb bit of editing has been done to keep the work of so many and diversified contributors within the prescribed limit set for each subject, without reducing their style to uniformity. $7.70 postpaid.

WORD SHADOWS OF THE GREAT—*By Thomas F. Madigan*

ONE of the most fascinating hobbies in the world is the collection of autographs and manuscripts, and we might add, one of the most expensive. It is not, however, necessary to own autographs to enjoy them Our libraries, museums, and historical societies are constantly showing material of this kind. Now we have a most entertaining book by a well-known dealer in autographs of celebrities, manuscripts, and historical documents. The technique of collecting is adequately described. It is very necessary for the beginner to avoid pitfalls and this is exactly where Mr. Madigan's long experience enables him to speak with authority. The many facsimiles are admirably chosen and are well reproduced. Mr. Edison quotes Gray's "Elegy" erroneously and Thomas Jefferson gives his opinion on the "liquor question" as it was called in those days. But why multiply tempting examples? The whole three hundred pages are filled with them. $5.20 postpaid—*A. A. H.*

THE LAND OF THE PEPPER BIRD—*By Sidney de la Rue*

LIBERIA, in all its phases of life—flora, fauna, customs, social and economic aspects—is portrayed by the author who spent a number of years there as Financial Adviser. The interesting return of the American Negro as well as the native cults, superstitions, and the dread black magic

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PROBABLY no better proponent of this particular style could be found than this modest youth who as an amateur was never beaten in a free style race. He tried out all methods, rejected some ideas and adopted others, and perfected the crawl stroke till he was acknowledged the greatest swimmer up to 400 yards the world has ever developed. Much of his knowledge and all of his training are devotedly attributed to his coach William Bachrach. A most interesting, readable story lavishly illustrated. $2.65 postpaid.

THROUGH BLOOD AND ICE *By Ferenc Imrey and L. S. Palen*

IT would seem impossible that any one person could have had such a varied experience of horror and suffering, yet the publishers state it is an "authoritative personal narrative." An Hungarian artist serving as corporal is captured and sent to a Russian prison camp- subsequently to Siberia. He escapes, is captured, escapes again, and eventually is evacuated through Vladivostok. A vivid picture of prisoner's life and the civil war between the Bolsheviki and the Whites. $3.90 postpaid.

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ORIGINATOR of the universal system of film photography, a pioneer in chemical research and in large-scale production at low cost while preparing the market by extensive advertising, the subject of this biography has been a potent force in the economic life of the nation, as well as a beneficent patron of culture and the arts. From an immense amount of material the author has produced an authoritative and vivid account which is delightfully readable. $5.20 postpaid.

THE GREAT CRUSADE *By Jennings C. Wise*

TWO methods of presentation are always indicated in the relation of any series of historical events and this is particularly true with regard to narratives of the late war. "All Quiet On the Western Front" was a most graphic presentation of the human emotions of the enlisted man. "Zero Hour," which had an extraordinary sale in Germany, likewise told of the disillusionment of a gifted youth of good family. It has remained for the present author, a man of education from old Virginia stock, who had previously served in the regular army and had lectured and taught military tactics, to give a critical account of the operations of the Blue Ridge Division as well as his extended observations along the whole battle front; facilities for which he was particularly fortunate in obtaining. Extremely well written, the facts are given without acrimony, yet there is no hesitation in calling attention to error and omission. It is no hero story, though one can not but thrill to the accomplishment of our under-trained and poorly supplied troops. Lessons for future protection are made obvious though with minimum comment. $2.15 postpaid.

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BEGINNING with the search for the northwest passage and continuing down through the heroic attempts to reach the poles, culminating in Admiral Byrd's recent spectacular accomplishment, here is a comprehensive account of high adventure which fires the imagination and stirs the blood. Maps showing the course of each major effort, with 32 reproductions of photographs, make this one of the most interesting and historically valuable of any of the titles on polar exploration. A chronology completes the text. $2.15 postpaid.

LAUD, STORM CENTRE OF STUART ENGLAND—*By Robert P. Tristram Coffin*

WILLIAM LAUD (1573-1645) lost his head in two senses. If he had been less of a tyrant he might have escaped the block. He was a powerful factor in Caroline England and brought down ruin all about him. Oxford owes much to him and he really did accomplish a great many reforms as he was all-powerful both in church and state. He was the Man of Thunder who became the storm center of the Civil War, but he preserved much of the ceremonial beauty of the Anglican communion. As Archbishop of Canterbury he wielded great power. An implacable enemy of the Calvinists, he even tried to reach the Colonists of New England; he tried to force his ecclesiastical system on Scotland, but failed. His infatuated policy at last brought on his impeachment, imprisonment in the Tower of London, and finally his sentence to death when he had some difficulty in getting the axe substituted for hanging. His mutilated body rests in his beloved Oxford but his best monument is the very fabric of the Anglican Church. $3.65 postpaid -*A. A. H.*

MAHATMA GANDHI'S IDEAS—*By C. F. Andrews*

GANDHI has been much in the limelight by reason of his civil disobedience campaign to secure Indian Independence. His mass disregard for the salt laws is front page news and when we last heard of him he was on tour in an automobile and having tire trouble in the cactus regions. Wherever he goes he spreads discontent, for he has an uncanny faculty for casting a spell by the sheer force of his personality. He is a powerful thorn in the Indian government's side but they were wise enough not to martyrize him by hurrying his arrest. We have often wondered what this Indian Moses really wants. He seemsal most as bewildered as anybody else. It is the mission of this book to try to make known the principles for which he stands, giving his thoughts and aspirations in his own words as far as possible. Gandhi is a legend, but a personified legend. The author has been with him on recent tours, therefore the information outside of Gandhi's writings is authentic. $3.15 postpaid--*A. A. H.*

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Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Secrecy of War-Time Inventions

GREATER secrecy for inventions useful in the national defense is proposed in the draft of a bill submitted to the House by the Acting Secretary of the Navy, Ernest Lee Jahncke, reports *The United States Daily*.

The proposed measure was prepared, he said, by the interdepartmental Patents Board as a substitute for one originally submitted by the Navy Department, and has the concurrence of representatives of the War and Navy Departments on the Patents Board.

"The efficiency and international superiority of all armament, equipment, appliances, and facilities for the Army and Navy," he added, "are of primary importance and are always the subject of first consideration on the part of the War and Navy Departments. Constant effort towards improvement and unremitting vigilance in the pursuit of it are practiced at all times by both departments.

"The only source from which the maximum of efficiency and the possibility of superiority may be hoped for is continuous invention. Of course, many inventions of military value are made in other countries and never come to light in the United States. Also many inventions that are offered to and are acquired by one or the other of the two military departments become public beforehand.

"However, a large number of valuable inventions, and sometimes fundamentally important inventions, are made by persons connected in some way with the government service and in numerous instances by patriotic citizens in private occupations, and are brought to the knowledge of one department or the other before any information concerning them becomes public. During such time as it is desirable to keep inventions secret, it is necessary that patents on them be not issued, because as soon as a patent is issued it becomes public. But for the proper protection of the government's rights in and to such inventions it is necessary that they be filed in the Patent Office with applications for patents thereon.

"While in the Patent Office, in the status of 'patent applied for,' an invention is a secret so far as the inventor and his assignee do not divulge information concerning it. In these circumstances, a legal method of maintaining for a proper time the secrecy of an invention of value to the Army or Navy is a vital need. This can be accomplished in the way that seems most feasible, all this considered, by filing applications for patents and holding back the allowable patents at the discretion of the department concerned."

Standardized Bottles

WITH the purpose of promoting exports, regulating distribution and standardizing types, the leading bottle manufacturers of Germany have formed themselves into a syndicate to be known as the German Bottle Sales Company, according to a report received in the Department of Commerce from Assistant Trade Commissioner A. Douglas Cook, at Berlin.

Both domestic and foreign sales will be handled by the syndicate. It is estimated that between 500,000,000 and 750,000,000 bottles (colored glass only) are produced annually in Germany. Exports, which before the World War amounted to about 35 percent of the output, have declined to approximately 20 percent. It is expected that the combine will be able to increase exports again.

The bottles concerned are especially beer, mineral water, wine, liqueur, and alcohol bottles. Under the new arrangements, all patented manufacturing processes will be pooled for the benefit of all members of the syndicate, thus avoiding competition between the different manufacturing processes.

British Tire Importation Decreases

BRITISH imports of rubber tires and tubes recorded a further extensive decrease (except as regards solid tires) in 1929, while exports in the same commodities, following a decline in 1928, evidenced considerable recovery, according to a report from Consul General John J. Davis, London, the Department of Commerce anounced recently. The announcement follows:

Imports of pneumatic outer covers were valued in 1929 at 2,143,739 dollars, against 12,808,555 dollars in 1927, inner tubes at under 400,000 dollars contrasted with more than 1,574,000 dollars, and solid tires at 455,000 dollars, compared with upwards of 800,000 dollars, but this last-named description rose by about 10,000 dollars above the value in 1928.

The cause of the marked decrease in imports of tires and tubes, the report stated, can be traced mainly to factories for these goods having been set up by certain foreign firms, in consequence of the imposition of an import duty as from April 12, 1927.

Oil Trademark Upheld

IN the case of Vacuum Oil Company versus Walter and Company, First Assistant Commissioner Kinnan held that Walter and Company, of Rio de Janeiro, Brazil, is entitled to register, as a trademark for lubricating oils, a mark consisting of the pictorial representation of a griffin with the word "Griffin" appearing thereabove and the notation "Domina Attricto" therebelow, notwithstanding the long use by the Vacuum Oil Company of New York and registration of a mark for the same goods consisting of the pictorial representation of a gargoyle, with the word "Gargoyle" thereabove.

The ground of the decision is that these marks are not so similar that their contemporaneous use would be likely to cause confusion.

In his decision, after noting that applicant had taken no testimony and that it appeared from the opposer's evidence that it was long prior in the field and had carried on a very extensive business and consequently doubt, if it exists, must be resolved against the applicant, the First Assistant Commissioner said with respect to the marks:

"Both parties have adopted a pictorial representation of a fictitious or fanciful creature, that of the opposer being only somewhat similar to an eagle as to the body although the head is quite dissimilar to such a bird, while the griffin simulates the head and wings of an eagle with the body, feet, and tail of a lion. The similarity of the two pictorial representations is very remote. The names of such fanciful creatures are likewise wholly dissimilar in spelling, sound, appearance, and significance. Unless it be held that the opposer is entitled to such an interpretation of its trademark rights as would preclude any rival in business from using any pictorial representation of a fanciful animal, however distinct from that used by the opposer, in connection with a name of such fanciful creature, it is believed the applicant is entitled to registration of its trademark."

With respect to the testimony as to the dress of applicant's goods and certain activities in connection with their sale and the former commercial relations between the applicant and the opposer, he said:

". . . but all these matters refer to activities in another country, Brazil, and are immaterial and irrelevant to the issue to be determined in the case at bar. The opposer has alleged that the applicant has not used its mark in interstate or foreign commerce in this country, but has submitted no evidence to support such allegation and it is thought the opposer is not entitled to raise such a question in the instant proceeding."

Patents and Trademarks In Panama and China

PATENTS and trademarks, of which the certificates of registration already have been granted, must be recorded in the mercantile register of Panama regardless of whether or not the company owning the registered patents or trademarks is doing business in Panama, according to information received from Assistant Trade Commissioner Fred C. Rogers, Panama City, and published in *Commerce Reports*.

As a result of the inclusion of such matter in the office of the Secretary of Agriculture and Public Works, and according to the provisions of the Commercial Code which became effective on July 1, 1917, all factory and trademarks and patents for inventions, for which certificates of registration have been acquired since that date, must be recorded in the mercantile register.

The provisional regulations for the promotion of industrial manufactures in China, promulgated by order of the National

Government on June 18, 1928, apparently limit to persons of Chinese nationality the right to apply for and obtain patents. According to these regulations, Americans, as well as other foreigners, will be unable to protect their patent rights, for under the clauses of encouragement which are intended to promote industry only Chinese may make application for permission to exploit new inventions and industrial processes.

It is understood that this matter has been brought to the attention of the Chinese Government on behalf of American citizens in order that their rights in patents may be protected against infringement.

Centrifugal Casting Process Claims Allowed

CLAIMS defining a process for the centrifugal casting of hollow bodies of steel have been allowed by the Board of Appeals of the Patent Office, *ex parte* John Chapman Bell. The claims had been rejected on the ground that they merely set forth the obvious way of using the apparatus disclosed, or one equivalent thereto. It was pointed out by the Board of Appeals that a process of treating matter to produce a given result, and a machine suitable to perform the process, constitute distinct entities, and if new and useful, each may form the subject matter of a patent independently of the other

The applicant stated that the essential novel features of his process lie in two manipulations The first consists in maintaining the nozzles through which jets of metal are delivered into the rotating mold at a constant distance from the surface upon which the metal is deposited The other consists in maintaining constant the pressure in the spout through which the metal is delivered to the mold

While it is undoubtedly true that the mere function of a machine is not subject matter for a patent, yet it is equally true that a process consisting of certain operations upon matter to change its form or condition constitutes patentable subject matter, if new and useful. This is true, even though such an operation may be performed by an apparatus devised to practice the process and such apparatus may have no other function.

Deceptive Advertising Discontinued

THE practice of advertising a concern as occupying an entire building in the conduct of its business when it only utilizes a part of the building, creates an erroneous impression upon the public trade, according to announcement by the Federal Trade Commission, stating that an individual so advertising had signed a stipulation agreeing to discontinue the practice. The Commission's statement follows:

Manufacturing and selling toy airplanes, an individual circulated advertising matter containing illustrations of what purported to be a picture of the building in which his business was carried on.

On the front of the building, as shown in the picture, appeared in large display type the following: "World's Largest Manufacturers, Model Airplane Sets and Supplies," and over the door of what seemed to be an annex of the building appeared the words "Shipping Department."

However, the business was limited to the manufacture and sale of miniature or toy airplanes and repair parts for them. The volume did not exceed 10,000 dollars a year. The enterprise was carried on in two small rooms of the upper story of a small building and no separate space was utilized for shipping.

Signing a stipulation agreement with the Federal Trade Commission, the individual agreed to stop circulating advertising matter which tended to create the erroneous impression that he occupied all the space in the building, and which contained the representation that he was the world's largest manufacturer of model airplane sets and supplies.

(Names of individuals or firms signing stipulation agreements are not mentioned in the Commission's press releases or publications, but the facts in the proceedings are presented to show methods of competition condemned by the Commission as unfair, for the guidance of industry and protection of the public)

"Must Sell" Must Not Be Used

TWO individuals in different parts of the country, engaged in selling and distributing diamonds in interstate commerce, signed stipulations with the Federal Trade Commission agreeing to cease and desist from use of the words "must sell" in an advertisement when there were no emergencies compelling the immediate sale of their products.

They advertised as follows· "Diamond ring. Must sell. Beautiful lady's setting. Large blue-white perfect cut diamond. For quick cash, 100 dollars."

Rural Electrification

ELECTRIC utility companies and the State administration in Ohio are cooperating in plans to extend rural electrification on a basis that will insure the widest possible use of electricity on the farms, was a recent oral statement of Governor Myers Y. Cooper, according to *The United States Daily*.

Conferences between the governor, representatives of the electric companies, the public utilities commission, the Ohio Farm Bureau Federation, and officials of the Ohio State Grange have been held on the subject and are producing results, the governor said.

One of the principal plans is to have the utilities provide lines to rural territory without cost to the farmers. Heretofore the subscribers have had to pay for the line, which in many cases made the cost prohibitive, the governor said. Further conferences are planned by the governor in which it is expected that a basis of mutual agreement will be reached.

"The administration feels that rural electrification is one of the most important social and economic benefits which possibly can be extended to the farmer and is bending every energy in bringing together a meeting of minds of the farm groups and the utilities interested on the basis of fairness and equity, making the program attractive to the farmer from the standpoint of costs."

Frozen Fresh Meat

THE rapid development of the quick-freezing process of preserving fresh-cut meats to be sold in packaged form is said to be one of the most revolutionary developments in food merchandising since the advent of canned foods, according to a recent oral statement on behalf of the foodstuffs division of the Department of Commerce.

The new system, it was said, calls for butchering the carcass promptly into individual cuts, which are frozen solid in air-tight wrappers and chilled to 50 degrees below zero. It is claimed that the quick-freezing process brings the meat to the consumer with the weight, flavor, texture, and appearance unchanged.

The present cost is about 2.45 cents per pound, which is expected to be reduced under large-scale production. Savings will be realized in the elimination of waste. Transportation savings are expected, since the space taken up by packaged meats is less, it was pointed out. (A similar method of preserving fresh fish was described in our issue of March, 1929.—*Editor.*)

Roofing Trademark Upheld

IN respect to the case of The Duro Company versus Central Paint and Roofing Company, First Assistant Commissioner Kinnan held that the Central Paint and Roofing Company of Louisville, Kentucky, is entitled to register, as a trademark for smooth surface and slate surfaced composition roofing, a mark consisting of the notation "Dur-A-Bull" and the pictorial representation of a bull, notwithstanding the prior adoption and use by The Duro

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60 Payment must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co, those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

Airplane—Having rotatable members operating independently of the wings, and adapted to adjustably receive air under pressure for increasing the lift, and acting as stabilizers for retarding rolling, pitching and slipping of the plane in the air Patent 1753112. George R. Engledow.

Pertaining to Apparel

Garter—Wherein a plurality of disengagable supporting members are connected with the shirt and hose in order to provide supports at

Company of Dayton, Ohio, of the notation "Duro" as a trademark for various goods used in connection with houses.

The ground of the decision is that the goods of the two parties are not of the same descriptive properties and the marks themselves are not deceptively similar.

In his decision, after noting that the opposition had been dismissed on the grounds above stated, the First Assistant Commissioner said, with reference to the goods:

"I am of the opinion that the decision of the acting examiner of interferences is without reversible error. Obviously the applicant's composition roofing is not of the same descriptive properties as any of the goods enumerated in the opposer's trademarks."

With reference to the marks, he said:

". . . it is equally true that the applicant's mark, consisting of the word 'Dur-A-Bull' and a pictorial representation of a bull, does not so nearly resemble the opposer's mark 'Duro' as to be likely to cause confusion or mistake in the mind of the public."

And then, after citing certain registrations to show that the term "Duro" did not originate with the opposer, he said:

"In view of the prior adoption and use by others of the word 'Duro' both as a trademark and as the whole or an essential part of the names of companies or corporations, it is believed that the opposer is not entitled to such broad protection of its mark as to exclude from registration the applicant's mark."

Type Font Patent Granted

THE Commissioner of Patents was in error in refusing to grant a design patent on a font of type known as "Cooper Black," the District Court for the District of Maryland has ruled, in ordering a decree entered requiring the issuance of the patent.

The plaintiff, in his action under section 4915 of the Revised Statutes, also sought to require the issuance of design patents on two other fonts known as "Cooper Old Style" and "Cooper Italic," but the court dismissed the action as to these, holding that it lacked jurisdiction under section 4915, as it read before the 1927 amendment, since an appeal had not been taken from the action of the Commissioner.

The question of jurisdiction was held to be governed by the statute as it stood before the amendment, since appeals were pending before the Commission when the amendment became effective. The court explained the jurisdiction under section 4915 both before and after the amendment in 1927.

A design for a font of type was held by the court to be a proper subject for a design patent. The claim for the "Cooper Black" font was not anticipated by the prior art, it was also ruled.

The court in dealing with the requisites for a design patent held that the tests of invention for such patents are the same as for mechanical patents, and there must be originality and exercise of the inventive faculty; in the former novelty and utility, in the latter novelty and beauty. In designs, it was stated, invention is measured by the appearance as an entirety when judged by the taste and fancy of an average person. The design must disclose at least a rudimentary esthetic appeal, it was pointed out.

distant points, without causing any undesirable pinching of the leg, and holding the shirt against rising. Patent 1753125. Max Lederman.

Toe-Dancing Shoe—A ballet slipper of the usual sandal type which will not pucker at the sides and is so constructed as to obviate the use of ribbon fastenings, but to draw the upper in hugging engagement with the foot. Patent 1754054. James Selva.

Heel Pad—For use between the heel of the foot and the inside of the shoe, an inexpensive elastic cushion pad for supporting the body and relieving the jars incident to walking on hard floors Patent 1756107. Tomizo Tanigawa

Chemical Processes

Granulated Product and Process for Making Same—A process for granulating dust resulting from the metallurgical reduction of arsenic bearing ores and material which comprises mixing said dust with sulphuric acid and water, agitating and at the same time drying the mixture Patent 1755985 Harry C Gardiner

Process for Treating Animal Hair and Wool with Chlorine—A process for carroting comprising applying to the hair or wool an aqueous solution of hydrogen chloride and a chlorate and oxalic acid and causing the substances to react with each other in contact with the hair and wool. Patent 1756723. Erich Bohm

Designs

Design for Lace—The inventor has been granted seven patents on ornamental designs for lace. Patents 80820, 21, 22, 23, 24, 25 and 80826 Ben A. Ball.

Design for a Dress -The inventor has been granted two patents, 80845 and 80846 Dorothy Long

Design for a Combination Airplane and Thermometer -Patent 80873 Frank Alessi.

Design for a Carton or Similar Container—Patent 80909. Frederick W. Peterson

Design for a Coat—The inventor has been granted two patents for ornamental designs. Patents 80899 and 80900 Dorothy Long.

Design for a Mirror or Similar Article Patent 80956. Edwin B Langsdorf.

Design for a Dress—The inventor has been granted two patents, 80957 and 80959. Dorothy Long.

Design for an Ensemble Suit—Patent 80958. Dorothy Long

Design for a Coat—Patent 80960 Dorothy Long.

Design for a Bracelet or Similar Article —Patent 81019. William Reichert

Electrical Devices

Electrical Plug and Socket Whereby the plug when its lead or contact arms are inserted in the socket will have an engagement with the socket in a manner to prevent accidental withdrawal of the plug. Patent 1753064. William Nonnenman.

Electric Measuring Instrument—A modified form of volt meter, for use with secondary batteries, primarily for giving indications to the driver of a motor vehicle the amount of energy in the battery at any particular time, or when recharging will be necessary Patent 1753043. Howard Butler.

Trolley-Wire Splice Joint—A two piece interlocking splice for resisting longitudinal separation, is particularly useful in splicing broken wires, providing a proper electrical contact and mechanical strength, and a smooth path for the trolley wheel in passing thereover. Patent 1754991. Samuel J. Evans.

Vegetable Oil Trademark

IN the case of The Southern Cotton Oil Company versus Globe Grain and Milling Company, First Assistant Commissioner Kinnan held that Globe Grain and Milling Company of Los Angeles, California, is not entitled to register the term "Westola," as a trademark for shortening for frying and baking foods, in view of the prior adoption and long use by The Southern Cotton Oil Company of the term "Wesson" as a trademark for a vegetable-oil product used as a shortening in the same processes.

The ground of the decision is that the goods are of the same descriptive properties and the marks confusingly similar as applied thereto.

In his decision, after noting that the testimony showed long and extensive use by the opposer and therefore, doubt, if any, must be resolved against the later comer, and noting applicant's argument that since its product is normally about the consistency of lard and sold in large quantities, whereas the goods of the opposer are usually sold in liquid form and in small containers, there would be no likelihood of confusion, the First Assistant Commissioner said:

"There is some attempt on the part of the applicant to show that the opposer's goods are not used for the same purpose as are the goods of the applicant but the evidence seems fairly satisfactory that the uses of the goods of both parties very largely overlap. Even if the applicant generally sells its goods in bulk to bakers, there is nothing to restrict its activities to this class of customers, or to prevent a considerable expansion of its business in connection with small quantities of its product put up in small containers sold to a different class of customers."

"Both marks employ the initial syllable 'Wes' while the remaining portions of the marks are quite dissimilar. It may be conceded that the first syllable of the applicant's mark is 'West' but when the entire mark is pronounced it is quite likely that the second syllable would be regarded by the public as made up of the letters 'to.' The first portion of a fanciful mark is more likely to be retained in the memory of a casual purchaser or observer than the other part of the mark. It would seem there is at least some probability that purchasers would confuse the two marks since they seldom have both marks before them at the same time for comparison but decide from memory and without much reflection."

With respect to the argument that although applicant's mark had been in use since 1920, no confusion had been shown, the First Assistant Commissioner, after noting that the testimony showed that applicant's sales had largely been on the Pacific Coast and in Honolulu, that it had never advertised its goods and that applicant, prior to the adoption of its mark, was familiar with opposer's goods and trademark, said:

"In view of these facts there is no showing upon which to base a holding that the goods of the applicant have appeared to any considerable extent in the same market and in competition with the goods of the opposer. No inference can, in consequence, be drawn that had the goods been in the same market with those of the opposer for nine or ten years no confusion would have arisen and, therefore, none would be likely to arise in the future

Electric Service Tray—Whereon different electrically operated units, such as a toaster, boiler, percolator, etc, can be removably disposed on the tray and electrically connected with a source of current; the tray is composed of two parts, the upper part being washable Patent 1755247. John S Fielding.

Of Interest to Farmers

Harrow—Adapted for removing roots of plants from the soil by means of a plurality of ground engaging teeth carried along a horizontal path by chains operated by the usual traction wheels, stationary at will, or with movement retarded. Patent 1754103. John M. Hjermstad.

Agricultural Device—A mechanism which may be used for various operations, such as seeding, discing, plowing, harrowing or cultivating, dispensing with labor ordinarily necessary, working the field backwardly and forwardly without supervision, other than starting and stopping, the operations being automatic Patent 1755247. John S Fielding.

Feed Grinder- Having a plurality of concentric rows of teeth projecting from oppositely disposed plates, movable in an inter-fitted relation so that the feed passing between the teeth will be thoroughly ground and ejected at the plate periphery. Patent 1755037 Tom Tamen.

Of General Interest

Ship's Pilot Ladder--A foldable portable ladder, the steps having roughened surfaces, and being of durable construction, consisting of but few parts which are interchangeable and readily assembled without requiring the employment of skilled labor. Patent 1753060. Andrew Myerstuen

Disappearing Lawn Sprinkler—A casing, with water actuated means for raising the nozzle into operative position above the ground and automatic means for lowering the nozzle and closing the upper end of the casing to prevent manipulation by unauthorized persons Patent 1751723. Charles A Borgeson

Adjustable Top for Type Cabinets—As used by compositors, consisting of a separate top above the type draws, and means for vertically raising and securing the top, at any desired elevation in accordance with the height of the user. Patent 1753048 Merritt W. Haynes.

Refrigeration Coil—With the tubes so arranged and spaced as to prevent icing of the coils to such an extent that the plant must be shut down long enough to defrost the coils. Patent 1753042 Charles M Brenner.

Movable Camera Support -Comprising a frame or platform, constructed to encircle a column, mechanism for raising or lowering the platform, a camera mounted thereon and adapted to move in spiral convolutions for taking pictures of the column surface. Patent 1751771. William L. Trullinger

Phonograph Construction- Provided with novel means for reproducing a plurality of tones in unison but from separate sound reproducing units As for example a separate sound reproducing unit for each member of a quartet. Patent 1752357. Hugo Wiener.

Crochet Needle--Having the usual hook at one end, but a needle point at the other, instead of being blunt, thus permitting other forms of work, a zig zag portion between the ends preventing slipping or turning over in use. Patent 1751796. Charlotte I. Denner.

Powder Puff—The back of which is formed of a plurality of members suitably joined, with a handle extending from the center and secured by novel means, the face-contacting surface having no out-stitching, thereby avoiding any roughness. Patent 1754090. Leonard Friedberg.

Match Package—Wherein a single or double arrangement of matches may be carried and the matches properly protected, while permitting the ready removal at any time and the ignition of the match as it is removed. Patent 1754036. Roman A. Novinsky and Edward O. Barton.

Compass- A marine compass, including a bowl, two liquids of different specific gravity, and a compass card having turning movement, and located approximately at the line of junction of the liquids, said card being supported solely by the liquid of heavier specific gravity. Patent 1754055. Frank G. Senter.

Egg Rack -Or shelf provided with a plurality of openings for supporting eggs in spaced relation and constructed to occupy a minimum of space, may be in "dead space" yet clearly exposed to view the articles carried. Patent 1754020. Albert J. Hyde

Window Construction Wherein means are provided by which each sash may be completely reversed into the room, for cleaning or reglazing, without removing outside screen or the like, adapted for use with standard window sashes and frames. Patent 1754316 Fred Hamilton.

Camera Attachment for Making Artificial Reflections—By means of an angularly disposed reflecting surface in a hood, attached to the end of the lens barrel, on which the object to be photographed is reflected, giving the impression of the mirror effect of still water. Patent 1755036. Jacob H. Sussman.

Umbrella Guard—In the form of a permutation locking device, connecting the staff and canopy of an umbrella, and locking the same, whereby the opening of the umbrella by all others than the rightful owner will be prevented. Patent 1755039. Harold M. Vandenhove.

Tile-Roof Closure—An interlocking metal plate which is easily applied to the lower end of a slanting roof, to fill the usual openings of standard tiles, and thus prevent the inconvenience caused by birds roosting under the corrugations. Patent 1752593 John Giordano.

Sewing Wire for Flat Rope- A composite sewing strand or lacing for metal rope composed of hard and soft wires, the soft wires being positioned outside the hard wires, to protect them from cutting contact with the strands of the rope when in use. Patent 1755018. Richard Nitsch.

Basement Circulator— A hose nozzle which may be lowered into and suspended in the hold of a ship, or basement, for fighting a fire, the water being thrown from the nozzle in an apron-like spray, substantially at right angles. Patent 1753686. Charles A. Borgeson.

Safety Apparatus for Oil-Storage Tanks - A fire extinguishing apparatus for preventing the oil from being ignited by lightning, by drawing off and condensing the vapors which arise in the air space above the oil, also providing an emergency steam pipe as a last resort. Patent 1753401. Henry J. Bucking.

Milk-Container Holder—For tapering paper milk bottles, the construction being such that when the handles are grasped part of the holder will grip the container and hold the same against movement while being tilted or carried. Patent 1755335. Max Roman.

Merchandise Package and Display Rack Therefor- In which a number of packages may be associated with the rack in such a manner as to require the tearing of the package to effect its release, whereby to thwart pilfering, particularly adapted for displaying handkerchiefs. Patent 1755927. Louis N. Levinsohn.

Window-Cleaning Device—A thin flat pad of absorbent material adapted to contain a washing fluid, together with a handle member detachably connected, which obviates the necessity of leaning out when cleaning the outer surfaces of the window panes. Patent 1755881. John J. Kilbride.

Demonstration Device—An educational apparatus for symbolically representing certain allegorical passages of the Bible descriptive of some of the views and visions of certain of the prophets, the primary purpose being for use in Sunday schools and similar assemblies. Patent 1755952. Charlie Gant.

Citrus Fruit Juice Extractor—Which is manually operated, extremely simple in construction and in which the parts are so assembled that they may be removed for cleaning and oiling, the device is compact and durable. Patent 1754591. Guy B. Baker.

Humidistat—Adapted to supply water to any evaporating medium to maintain proper humidity in the air in a room or house, the device is provided with novel means for automatically regulating and indicating the humidity. Patent 1755276. Roy B. Somers.

Glove - Drying Rack — Whereon rubber gloves used in hospitals, or other places, may be quickly and thoroughly dried inside and outside after each washing, all the fingers being held open with the closed ends extending upwardly. Patent 1755902. Salvatore Tascarella.

Scale and Attachment for Reducing and Enlarging Cameras---Wherein means are provided whereby the scale and associated parts may be adjusted to take care of any slight variation in the focal length of the lens used, without being made especially therefor. Patent 1755177. Arthur Fruwirth.

Animal Trap--More particularly a trap for catching rats, which operates automatically by the weight of the animal as it enters, killing and removing the prey, and re-setting itself, ready for the next victim. Patent 1755947. Walter G. Baker.

Nonspillable Container—An automatic closure for a glass or container for liquid, which will permit the contents to be poured therein, or withdrawn therefrom, while preventing spilling if accidentally tilted, or during transportation, thus preventing soiling of clothes, etc. Patent 1756249. Solomon Kaufman.

Key Case—Of the type having individual key holders connected with a carrier plate, the latter being attached to a flexible and foldable cover adapted to enclose the keys and render each key conveniently accessible when the cover is opened Patent 1756627. Joseph Brewer.

Handle-Adjusting Means—For connecting a handle with a brush head by means of a threaded hole, and permitting the handle to be readily swung laterally at various angles, spring pressure securing the handle assemblage to the base Patent 1756801. Charles S Trippeda and Anthony J. Dichiaro.

Hardware and Tools

Regulator for Windows and Doors—A rotatably mounted shaft, particularly adapted for use with outwardly opening casement windows having inside screens, whereby the window may be readily opened or closed from within the room, without moving the screen. Patent 1751718. Eric Sodergren.

Rotary Core-Drill Attachment—Employing a greatly simplified gyroscopic element which will operate to determine the exact direction in which an inclined stratum of earth dips, so that the crest of an anticline may be determined by a series of drilling operations. Patent 1751678. Arthur L. Armentrout and Elwin B. Hall.

Blade Holder and Handle—For safety razor blades, formed from a single sheet of metal providing a pair of arms defining blade clamping jaws, so constructed that pressure effects a limited separation to allow the removal or insertion of the blades. Patent 1758459. James A. Gafney.

Wire Splicers—Specially constructed for carrying out wire-splicing operations quickly and easily, and which is especially useful for splicing the ends of fence wires closely arranged with respect to each other. Patent 1754023. Sidney J. Jones.

Draw-Punch—By means of which holes may be cut into sheet metal of any thickness, is especially adapted for electrical work for cutting holes in metal boxes, or for cutting in places where little room is available. Patent 1754568. John C. Nischan.

Heating and Lighting

Incinerator—Wherein articles may be dropped from above into the oven, while a blast of air acting as a damper, prevents gas or smoke from escaping through the opening by which articles are fed to the furnace Patent 1755027. Aatto P Saha

Household Utilities

Combination Stool, Ladder and Kitchen Block—Comprising a stool about the proper height for working at a kitchen sink, a step-ladder higher than an ordinary kitchen chair, and the top forming a meat block adapted for conveniently chopping or cutting meat. Patent 1753372. Richard G. Gober.

Card Table—Composed entirely of metal, having hollow legs constituting ash receptacles, the corners of the table having depressions and openings registering with the hollow leg tops, the depressions being convenient for the support of glasses Patent 1756777 Frederic E Wright.

Machines and Mechanical Devices

Flotation Machine—Whereby the pulp is thrown in the form of a film or attenuated condition into a gaseous medium for maximum aerating effect, producing flotation with a minimum of energy and a maximum of aeration. Patent 1752434. Albert L. Howard.

Guide Device—Which may be readily installed in position on the pump rod of a windmill to maintain the same accurately in line and thereby reduce loss of power by eliminating undue friction and wear. Patent 1753126. Arthur L. Ligon.

Sewing-Machine Threader—An attachment for sewing machines comprising a swingably mounted bar, having a semi-conically shaped end formed of a pair of spring-pressed members which provides a guide for the thread to the eye of the needle. Patent 1753114. Allan McC. Fluharty.

Apparatus for the Reduction of Impurities Contaminating Molten Metal—Comprising an open vessel formed of a metal shell and a refractory lining, in which the improvement of the metal, by the reduction of certain impurities, is brought about by forcing air upwardly through the molden charge. Patent 1753891. Llewellyn Jones.

Device for Expanding and Mounting Piston Rings—Whereby piston rings may be expanded, and positioned in expanded condition in juxtaposition to their piston groove, into which they may be forced by hand, breakage through over-strain being practically eliminated. Patent 1755044. Kenneth J. Bailey.

Bagle-Forming Machine—Which receives a batch of dough, forms the same into strips, cuts it into sections, and rolls the sections into rings, ready for cooking, the entire treatment being automatic, without the dough touching the operator's hands. Patent 1755921. Louis Gendler.

Methods of Pitting Fruit—A machine particularly adapted for pitting dates, having in view the removal of the pit from the fruit without unduly mutilating the fruit, as well as insuring precision and reliability in operation. Patent 1755872. Anthony Gotelli.

Grinding Machine—Characterized by a novel form of means whereby the grinding elements and the holder thereof may be readily adjusted to the proper size for grinding worn engine cylinders of varying bore diameters. Patent 1755862. Alvin R. Berck.

Belt Replacer—Which may be readily handled by a single operator for replacing a belt on a pulley, and operated from an advantageous position without danger from the usual revolving shafts and pulleys, and without stopping the machinery. Patent 1755876. Frank L. and Wilson R. Homstead.

Fruit Pitter—Which will sever the flesh from the stones of peaches, apricots, etc, the flesh being cut into two halves, and removed from the stone, which is held while the flesh is severed therefrom and then automatically released. Patent 1754636. Alvan B. McCollom.

Apparatus for Applying a Soft Metal Surfacing to Hard-Metal Plates—By flowing said substance while in a fluid molten state onto the plate over a heating medium, while automatically smoothing off the coating substance to a uniform thickness prior to cooling off the medium. Patent 1756739 August Gunthard

Medical and Surgical Devices

Biproximal Tooth and Interlocking Key—A substitute for the natural tooth, and device for attaching the substitute tooth or teeth to any of the recognized abutments, characterized by the fact that it can be used in fixed or removable bridgework and dentures Patent 1753644. Fred E Burden

Musical Devices

Method of and Apparatus for Employing Tuning Forks to Generate Audio Frequency Current as a Medium for Sound—A musical instrument, a tuning fork, and an electromagnet positioned in space relation between the prongs, an electro-mechanical sound reproducer and means for amplifying the current in a suitable form of telephone or loud speaker Patent 1753069. Max Schumm.

Prime Movers and Their Accessories

Piston for Internal-Combustion Engines—Consisting of a metal having a great coefficient of expansion, and cross members of a metal having a small coefficient of expansion fitted at one end into the peripheral part of the piston thereby eliminating danger of gripping. Patent 1756884. Charles Schaeffer

Pertaining to Recreation

Boxing Glove—Constructed with a novel form of grip which is disposed within the glove permitting an unobstructed palm portion, thereby obviating danger of injury such as would be occasioned by grips protruding beyond the palm surface of the glove. Patent 1752977. Frank Dieterle.

Fish Lure—Constructed of such material as to be always bright and shiny, having the proper balance and weight to be useful for trolling or casting, and when used in casting will not be unduly impeded by the resistance of wind. Patent 1755047. Chester A. Braidwood.

Fishing Gear—In which one or more attractors, in combination with a sinker, are disposed slidably relative to a fish hook, so that the attractors will freely recede from the hook when the fish is hooked, thereby facilitating landing. Patent 1754567. Gwendolan Newell.

Dog-Racing Apparatus—Wherein a mechanical rabbit is caused to travel around a track and maintain its position ahead of a pack of dogs, a novel form of trap being provided for the ultimate disappearance of the rabbit. Patent 1755676. William R. Twiford and George Oehler.

Amusement Device—A combination merry-go-round and see-saw which may be conveniently used on play grounds or beaches, whereby a plurality of persons may oscillate or see-saw and at the same time revolve about a vertical axis Patent 1756851 August de Freitas

Pertaining to Vehicles

Collapsible Kiddy Car—In which the supporting legs and steering handle can be folded into substantially parallel position with respect to the seat, when collapsed will take up very little room, and may be shipped in a small container. Patent 1751765. Thomas G. Shannon.

Hood Ledge Plate and Multiple-Compartment Hood for Automobiles—Whereby a large percentage of the space not reserved for the machinery, may be formed with separate compartments for storage purposes, yet the hood may be reduced in weight and at the same time strengthened Patent 1754086. Earl Feileke.

Apparatus for Measuring and Indicating Efficiencies—Having means whereby the operator of an automobile or aeroplane, may know the speed at which his machine has the highest efficiency, whereby he may become aware of the best adjustments, and the best fuel suited for the machine. Patent 1754039. Otto A. Pawlick and Raymond C. Giese.

Releasing Coupling—For use in connection with pulling vehicles, such as tractors, and drawn vehicles, such as plows, for releasing the plow should it encounter a rock or other obstruction, to avert injury or breaking of parts. Patent 1754018. Fred W. Reimold.

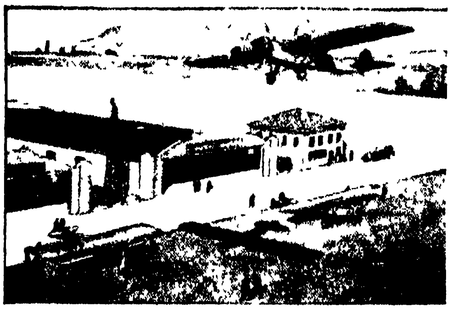
Clutch-Protecting Device—An attachment designed to protect a clutch mechanism from undue wear and tear, incident to the habit of "riding the clutch pedal," which causes the clutch parts to wear unnaturally, the attachment is capable of being easily installed. Patent 1755002. Charles M. Hibbets.

Spring Boot—Comprising a sheet of flexible and liquid-proof material constituting a liner, adapted to embrace a spring, for the protection, retention of lubricants, and permanent preservation against deterioration by exposure to the elements. Patent 1753257. Alfred R. Ulp.

Vehicle Spring—Which permits greater vertical play, adds to the length of the working wheel base, transmits less vibration, prevents distortion of the frame, counteracts momentum in rounding corners, and can be adjusted to meet varying loads. Patent 1753420. Joseph N. Johnson.

Automobile Radiator Cap—Having an outwardly-closing, inwardly-opening valve which permits the filling, or addition of water to the cooling system, without the necessity of removing the cap, thereby eliminating the danger of scalding or injury to the car finish. Patent 1755316. Francisco O. de Alcocer.

Berry-Picker's Vehicle—An argicultural machine whereon a number of persons may be drawn over a berry patch supported in a convenient leaning seated position, with their hands free to pick berries, and their backs relieved of strain. Patent 1756803. Jacob D. W. Williams.



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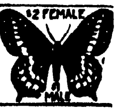

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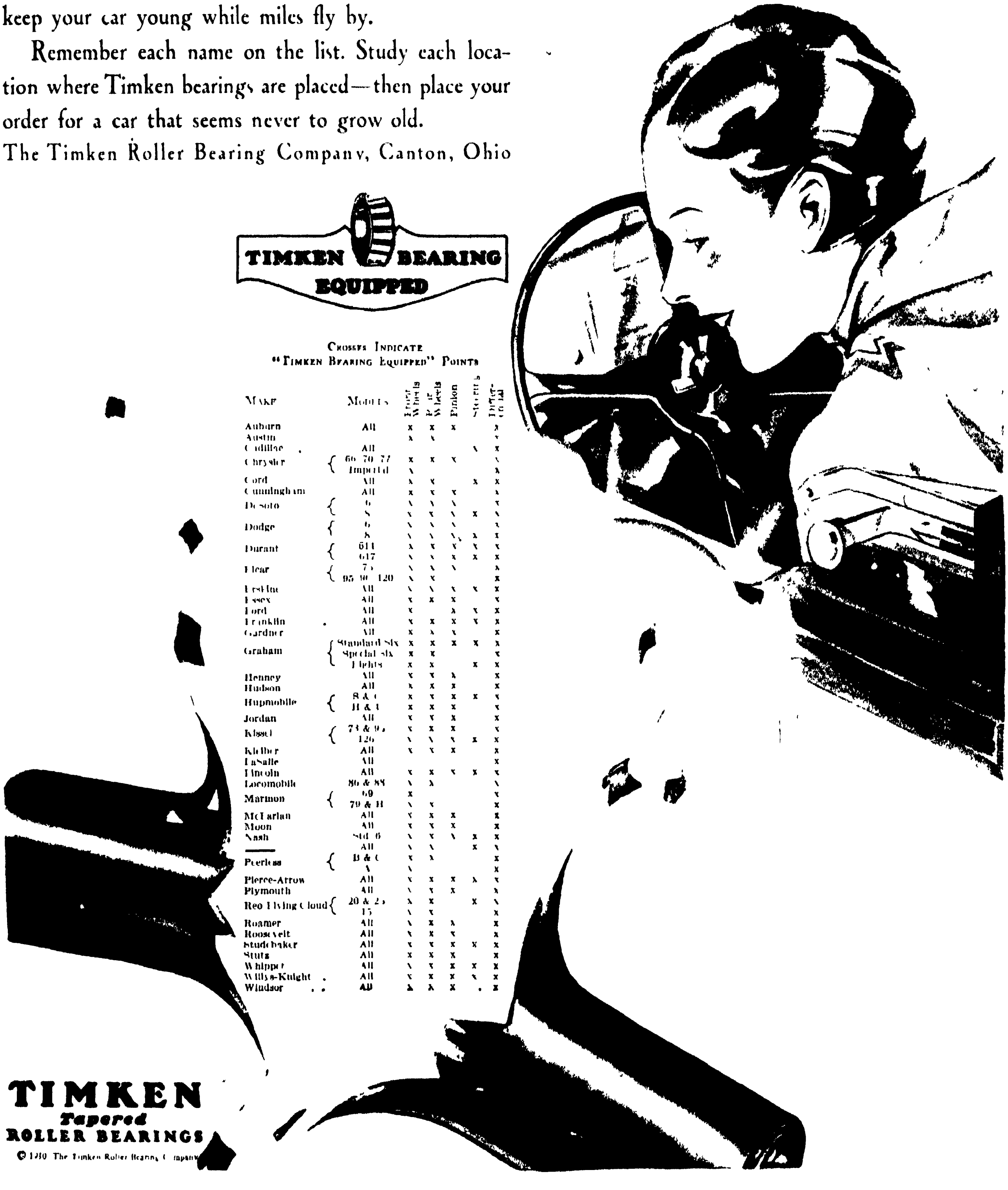

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Cunningham	All	x	x	x		x
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	8	x	x	x	x	x
Dodge	6	x	x	x		x
	8	x	x	x	x	x
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	617	x	x	x	x	x
Elcar	75	x	x	x		x
	95 96 120	x	x			x
Erskine	All	x	x	x	x	x
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Ford	All	x		x	x	x
Franklin	All	x	x	x	x	x
Gardner	All	x	x	x		x
Graham	Standard Six	x	x	x	x	x
	Special Six	x	x			x
	Eights	x	x		x	x
Henney	All	x	x	x		x
Hudson	All	x	x	x		x
Hupmobile	S & C	x	x	x	x	x
	H & U	x	x	x		x
Jordan	All	x	x	x		x
Kissel	73 & 95	x	x	x		x
	126	x	x	x	x	x
Kleiber	All	x	x	x		x
LaSalle	All					x
Lincoln	All	x	x	x	x	x
Locomobile	86 & 88	x	x			x
Marmon	69	x				x
	79 & R	x	x			x
McFarlan	All	x	x	x		x
Moon	All	x	x	x		x
Nash	Std 6	x	x	x	x	x
	All	x	x		x	x
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	A	x				x
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	15	x	x			x
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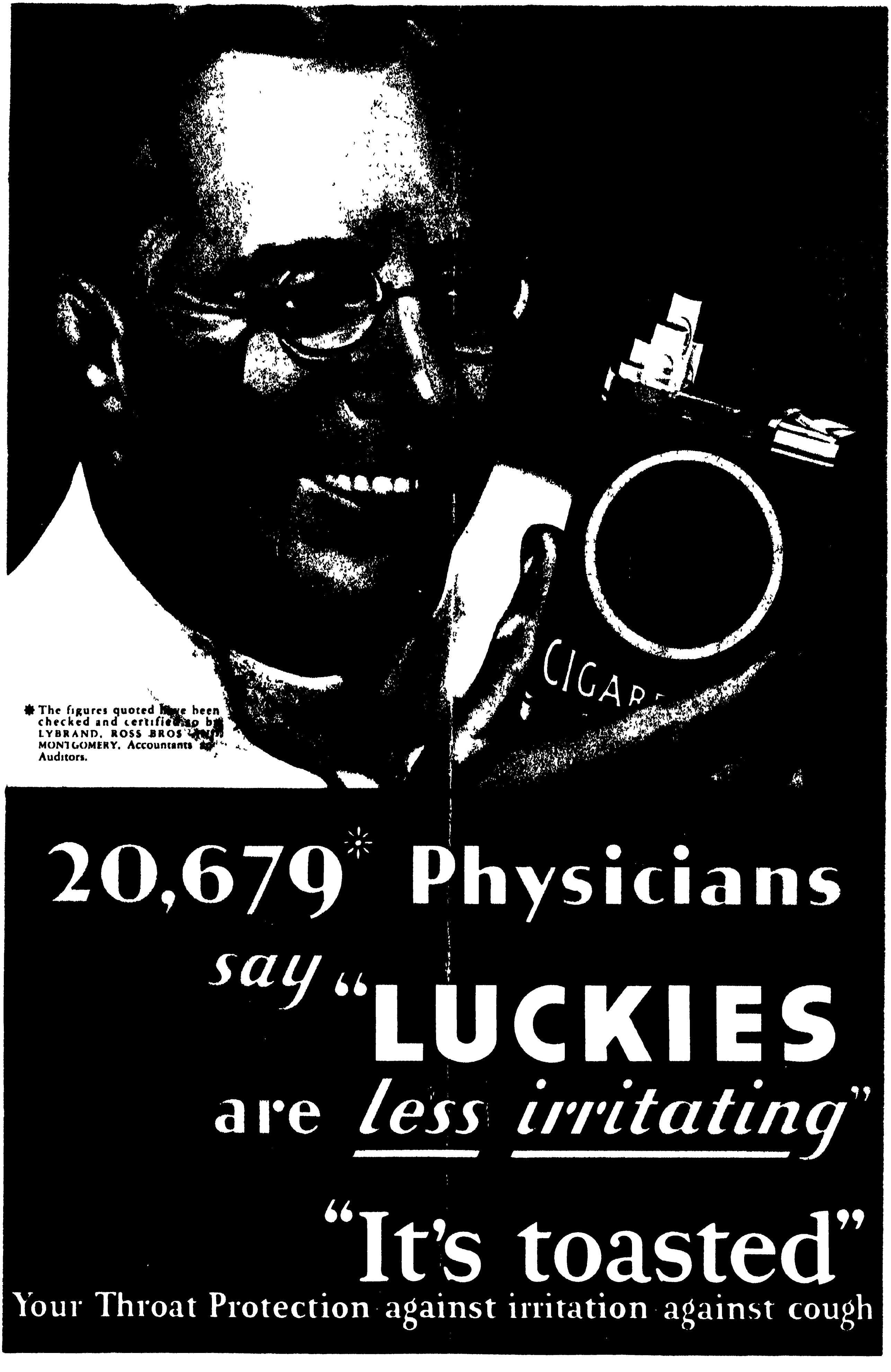

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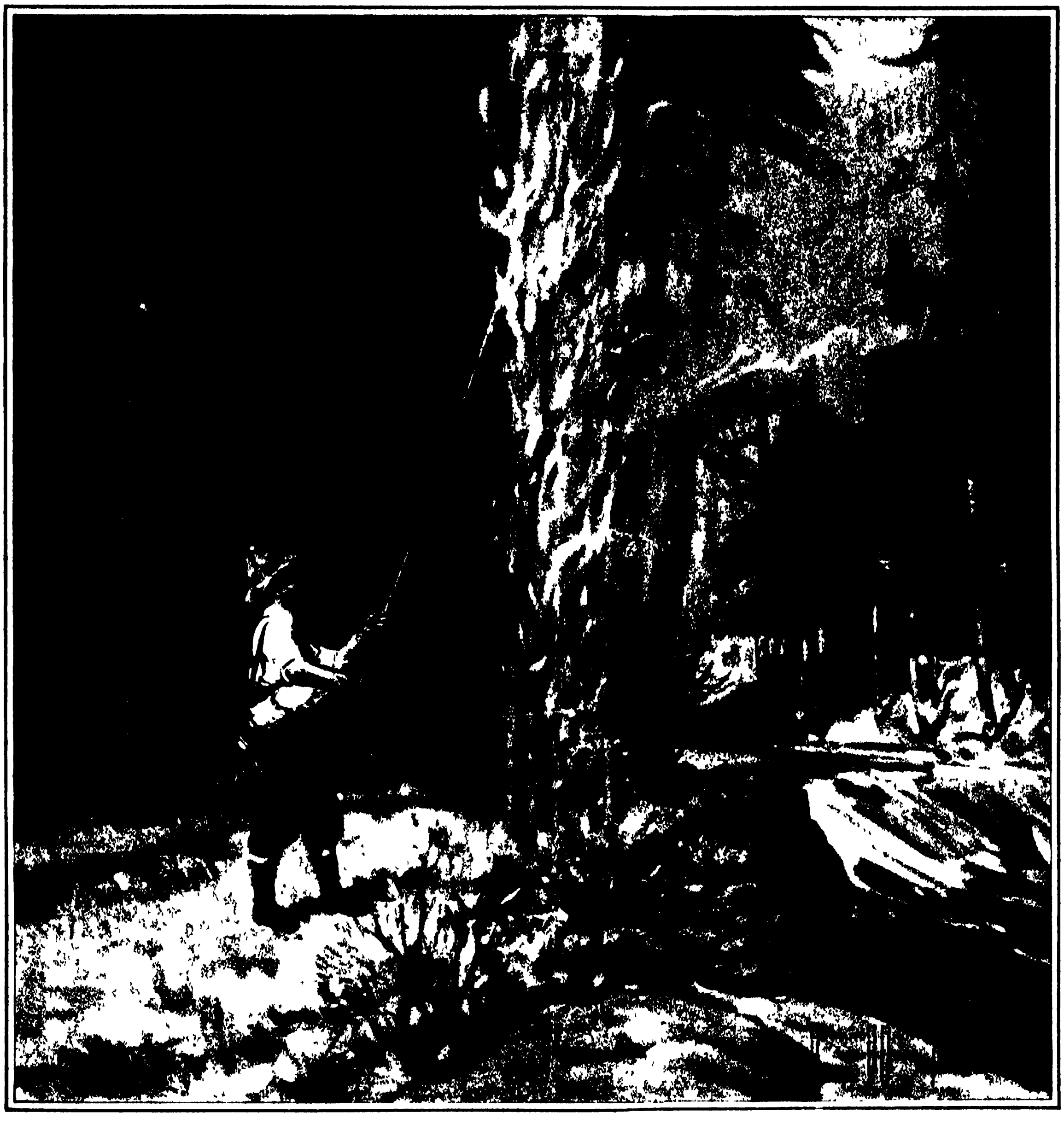
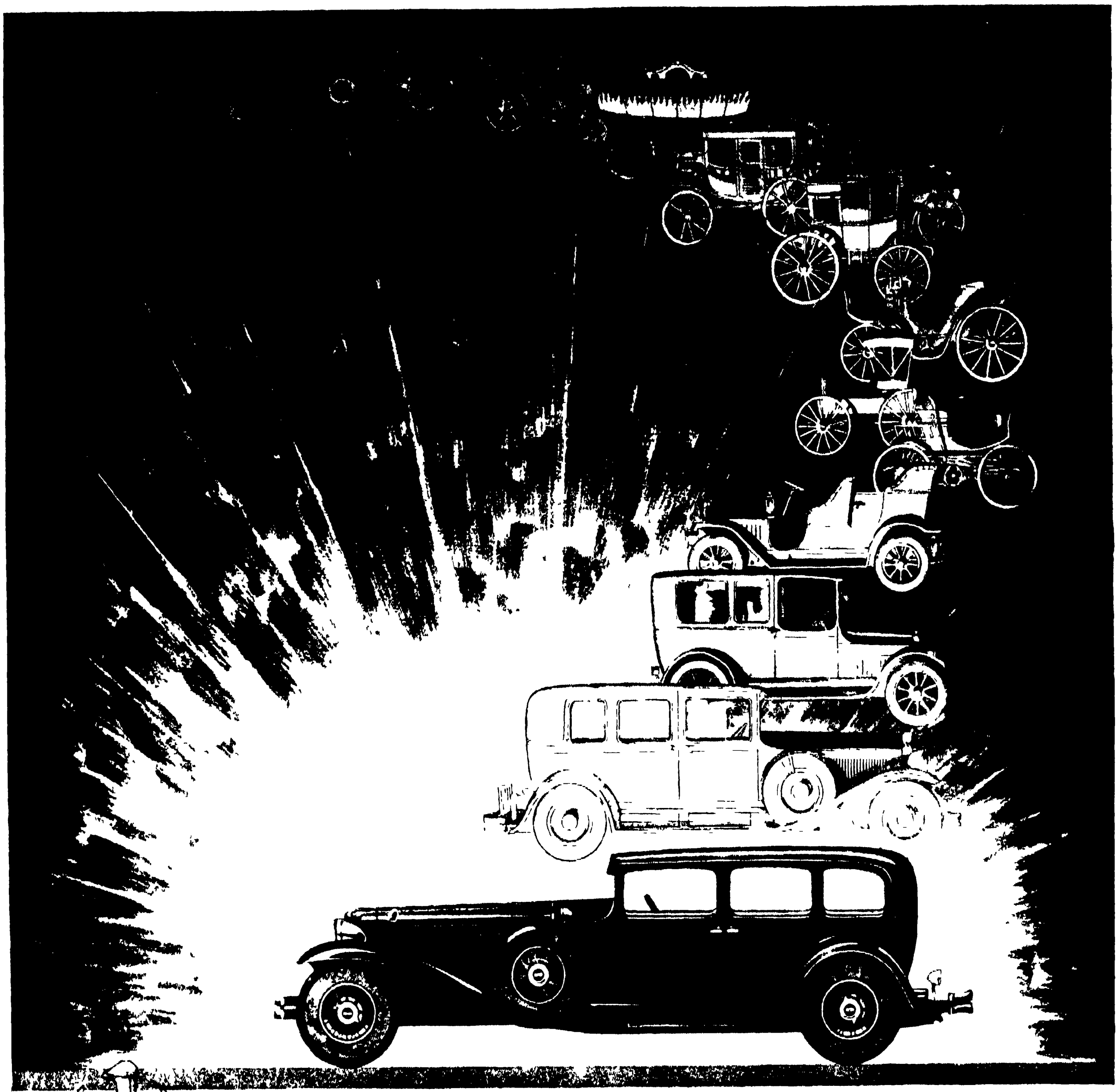


Fighting Bark Beetles With Fire



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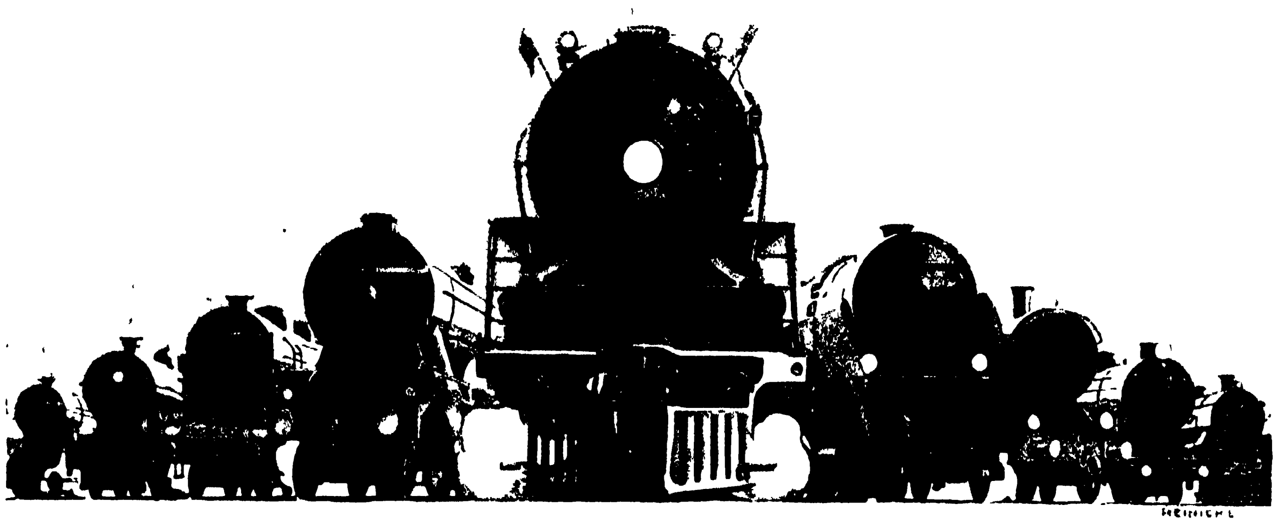

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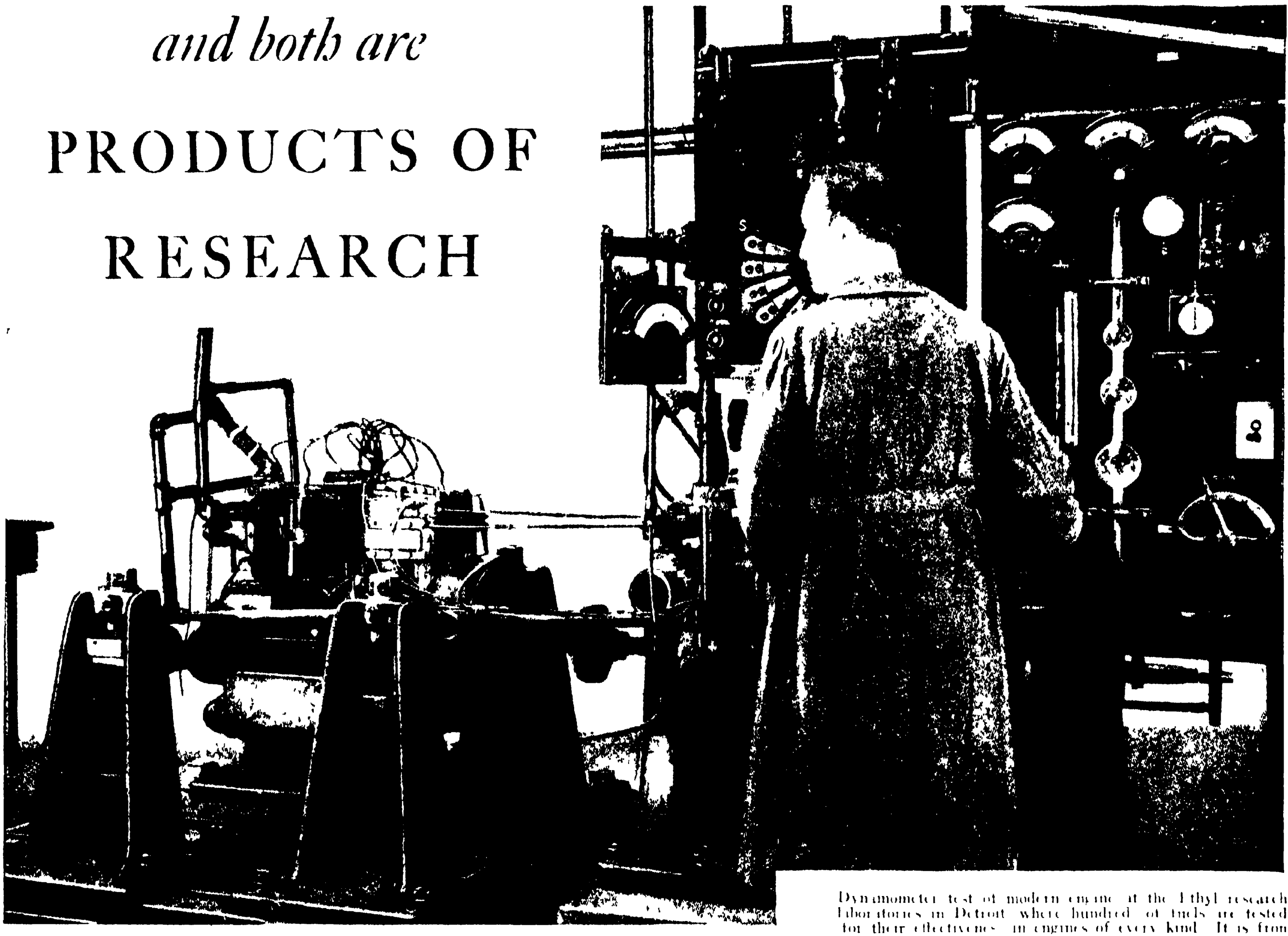

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COVER

In sections of the west, a beetle which makes its home under the bark of trees has been making heavy inroads on the forests. Our cover this month, painted by Howard V. Brown, shows the latest and most effective method yet conceived to destroy the pests: the scorching of the bark by spraying kerosene on the trunk and setting fire to it. Turn to page 136 for the article concerning this work.

New Frontiers of Physics

By Paul R. Heyl, Ph. D.,
Physicist, U. S. Bureau of Standards

AMONG present-day scientific writers it is doubtful that anyone has a more brilliant flare for the explanation of obstruse scientific facts in terms understandable to the layman, than this well-known physicist and outstanding thinker. Matter, energy, space, time, gravitation, cosmology, wave atoms, these high points indicate the extent of this new work. It is broad in scope, medium in depth and contains much solid lean meat, no fat, no padding and almost no mathematics. A timely work for those who wish to keep abreast of the times.

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Across the Editor's Desk

WE'RE quite aware that the call of the outdoors, of sports, and the like is stronger than the appeal of science right now, but this month we've given you some absorbing features you won't dare pass up and others that will add scientific interest to your vacation trips. Take, for example, Dr. Russell's article on the green flash. Maybe you've never heard of the green flash, but here's your chance to see it— if conditions where you are going are just right or to see the mirages which he also discusses. They are never-to-be-forgotten sights. During the past year Dr. Russell has been traveling here and there in Europe and the Levant but expects to return to his duties at Princeton soon.

And those insects which you see walking on water while you're in the country another article tells how they do it. The secret is in the surface film of the water. Now if this surface film were so tough that human beings could emulate the water skipper, how would you like your high diving then? Another article is an "appreciation" of the hoary old man of the meadows: the sycamore; still another warns you to "be careful with fire while in the woods" but it also tells of the extensive system of forest fire protection and fire fighting necessary in this careless country. Summer heat may make you wish that you could, when traveling, sleep in the refrigerated dining car described on page 108, but it just isn't being done. You may dine in such cars soon, however.

"Zoogenesis" doesn't sound like light summer reading but it concerns a subject that concerns all of us: the new theory of evolution. Whichever side you're on, you will want to know this theory. The article was written by Dr. Austin H. Clark, a note about whom you will find on page 87. When his theory was first announced months ago, it was sadly distorted by the newspapers but we went straight to the source and got Dr. Clark's own story.

Unlike the daily press, you know, we don't try to give last minute news just because it is new; we choose our features carefully and then get the man who has made the theory or performed the experiment to write it up for us, but only after it has simmered a bit. "Basic Patents in Evolution," for example, was written by invitation after a member of our staff heard Dr. Gregory give a talk on the subject before the Explorer's Club. By the time he could put into writing the substance of his talk, he was on his way to Africa, and the manuscript of his series was written on the deck of a steamer in the Red Sea.

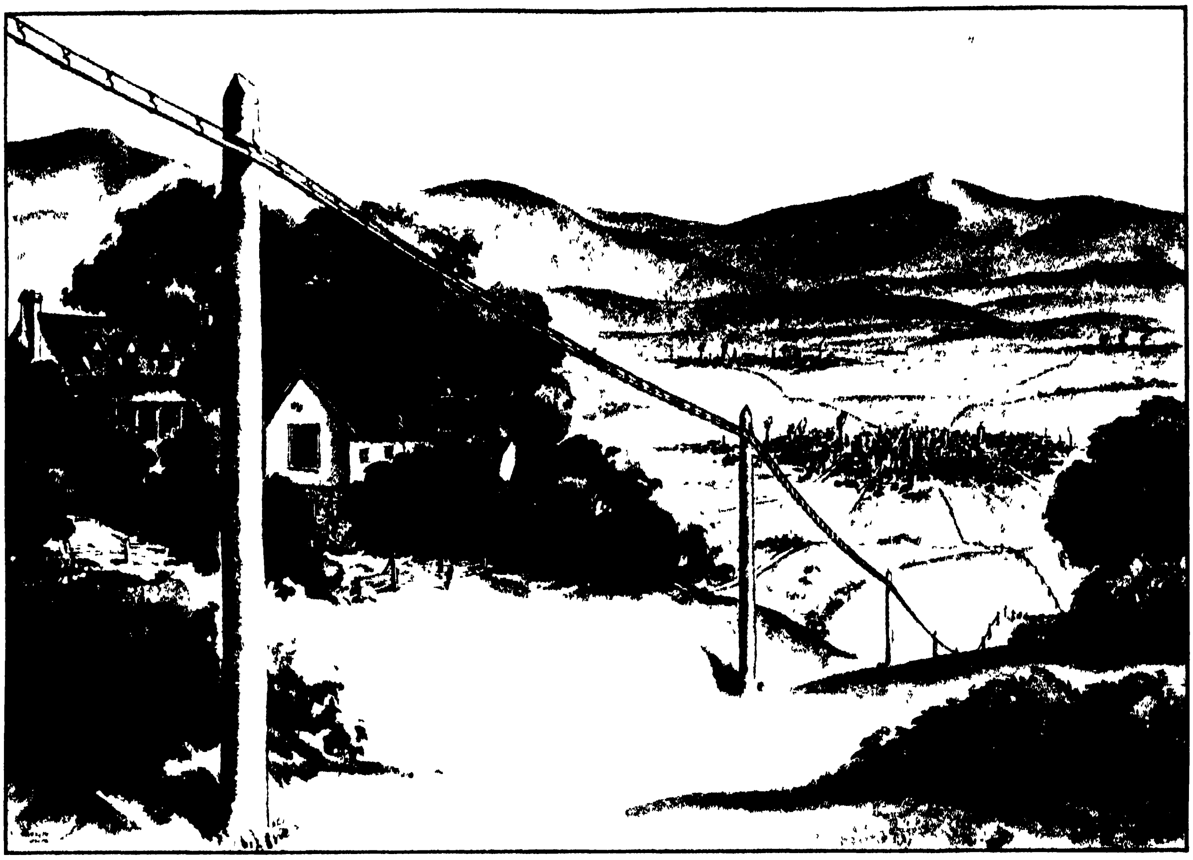
But enough of this. There are other good features in this issue on the burying of a river in a gigantic sewer, on industrial fatigue by the well-known Dr. Laird, on perfumes, a home-made cheap microscope, and many others—but what of the future? Well, for next month we've scheduled a number of excellent articles.

First of all, there will be one about a subject which has probably puzzled you often: the science of building a railroad. And we warrant that you will be surprised when you learn how many thousands of dollars it takes to lay one mile of shiny rails— so many thousand feet of rails, so many kegs of spikes, so many cross-ties, and so forth. Another discusses volcanology. As you have surmised, the word simply means the study of volcanoes; and the article is as interesting as volcanoes are mysterious. Dr. Jaggar, who wrote it, has been the next door neighbor of so many volcanoes that he can, and does, let us in on many of their secrets. He now lives and works in a little house on the rim of the crater of Mount Kilauea, Hawaii.

You may expect an absorbing story of the Indianapolis race which was run on May 30. This will cover the scientific aspects and give some of the highlights of the spectacular performance. Water sports come in for their share of space also, for the building of the yachts to defend the America's cup is a highly specialized science. You'll be treated to a story of the races for which these yachts were built.

Of course we can't begin to go into detail regarding all that is to come. The foregoing articles are simply a few samples. There will be others in true SCIENTIFIC AMERICAN style; and that naturally means that your interest was considered when we scheduled them. We hope you'll enjoy them all.

Orson D. Munn



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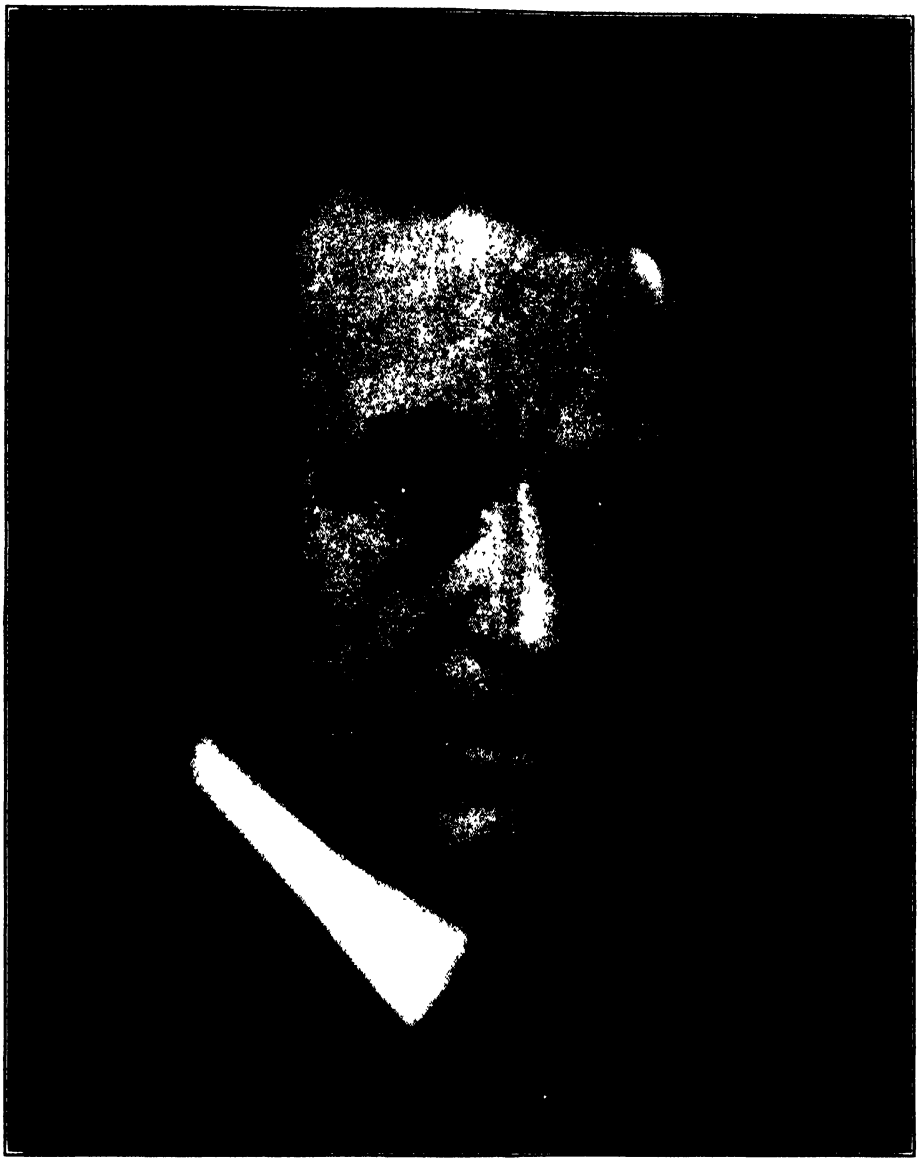
So that you may telephone from house to house in a Southern village, from farm to farm in the Middle West, or from the Pacific to the Atlantic Coast—the Bell Telephone System *must* be large. Its work is to give adequate telephone service to one of the world's busiest and most widespread nations. There is 4000 million dollars' worth of telephone plant and equipment in the Bell System, any part of which is subject to your call day or night.

Every resource of this system is directed to the end that you may have quick, clear and convenient telephone service.

In order to meet the telephone needs of the country most effectively, the operation of the Bell System is carried on by 24 Associated Companies, each attuned to the area it serves. Working with these companies is the staff of the American Telephone and Telegraph Company, giving them the benefit of its development of better methods.

The Bell Laboratories and the Western Electric Company utilize the talents of thousands of scientists for constant research and improvement in the material means of telephony. Western Electric, with its great plants and warehouses in every part of the country, contributes its specialized ability for the precise and economical manufacture of equipment of the highest quality for the entire system.

The Bell System is vigorously carrying forward its work of improving the telephone service of the country. It is building for today and tomorrow—for the benefit of every one who lives and works in America.



Austin H. Clark

ABOUT a year ago, as many will recall, newspaper accounts, some accurate and some not, concerning a new and rather extraordinary theory of evolution proposed by Dr. Austin H. Clark, widely known zoologist of the United States National Museum, attracted the attention of the scientific world. "Zoogenesis" is the general name Dr. Clark employs to cover his theory about which he has just published a semi-popular work "The New Evolution—Zoogenesis." He also has prepared for this journal the article on the same subject, which starts on page 104. Since the new theory of evolution was announced it has been discovered that Dr. Clark's career in science parallels that of Charles Darwin, the famous proponent of another theory of evolution which has made history. Like Darwin, Clark never was a "closet student"; for 30 years he has traveled widely and observed actual things in Nature. Both scientists spent many years studying at first hand a wider scope of material than the average zoologist finds accessible. Clark specialized in the study of birds and insects and then, to enlarge his point of view still more, he spent some years specializing in oceanography as did Darwin. Both also made long cruises on specially equipped sea vessels, Darwin on the *Beagle*, Clark on the *Albatross*. Only after so catholic a study of the interrelationships of the different forms of animal life can a man of science feel equipped to synthesize a broad theory such as Clark's theory of evolution—Zoogenesis.

Courtesy of The Logan Museum Beloit College

Halvor L. Skavlem

MORE expert at flint flaking than any of the living Indians, who have wholly forgotten the art, Mr. Skavlem, son of a pioneer Norwegian family of Wisconsin, can duplicate early Indian flint artifacts so skilfully that no one in a test has been able consistently to distinguish the two. Mr. Skavlem, now 84, continues to make artifacts at his summer home at Lake Koshkonong, Wisconsin, his motive being a scientific interest in the art. He has clearly exploded the previous notion that it was a "secret" and a "mystery," and proved that the white man of normal manual dexterity can learn to perform it as neatly as the red man. Alonzo Pond, the well known anthropologist of Beloit College, has described his work in a book.

The fighting front line. Bringing up a hose from a water tank

Fire: the Enemy of Our Forests

By CHARLES W. GEIGER and WALLACE HUTCHINSON

PERCHED on the top of a rugged mountain peak stands a small square house with steep sloping roof to shed the heavy winter snows, and with long windows on all four sides. From this elevated lookout point during the fire season, sharp-eyed sentinels scan the vast expanse of green forests stretched on all sides below them, searching, always searching for the telltale wisp of smoke that marks the newly started forest fire.

This scene, common enough in the great forested areas of the west is somewhat rare in the east, but the disastrous fires of the past spring have brought home to many people the fact that the east needs many more lookouts. In the west a forest fire as a rule rages through woods without endangering very many habitations; in the east many farms and villages have been wiped out by fires that began in the forests. In either case, the monetary loss often runs into millions of dollars and yet it is a strange trait of human nature that very little thought is given to forest-fire prevention, and it has always been difficult to obtain appropriations necessary for such work.

OUR forests are one of our greatest natural resources. They furnish a playground for thousands of vacationists and nature lovers and are the storehouse of waters that feed our lakes and rivers which make year 'round hydro-electric power possible. They furnish lumber, pulp for our paper, and many other necessities of life. The people of the United States use in house-building and otherwise, two fifths of all the wood consumed in the world. To perpetuate the source of supply, federal and state governments are practicing reforestation and have expended every effort to save our forests from the fire menace. In carrying out this huge task the most modern equipment is used whenever possible.

The guard may report a fire by either telephone or heliograph

In cities and towns fires are usually discovered shortly after breaking out. In the mountains, however, extensive areas of our forests are so thinly populated and afford such obstructed views because of mountain ranges and deep canyons, that fires might become very large before they were discovered if some special means of detection were not employed.

IN California and many other states, a careful watch is maintained over forested areas by United States Forest Service men stationed on high peaks, who act as fire lookouts, and by fire guards or patrolmen who travel along ridges and other routes where they have a good view of areas in which fires are likely to occur. The lookout men go to their stations in the high mountains early in the summer and remain constantly on duty, from daylight to dark, until the first rains come in the fall. Food supplies and mail are sent to them by the rangers. These lookout men occupy small buildings or observatories with windows on all sides. Many of these houses are set on steel towers 30 to 60 feet above the ground, so that the lookout man can see over the surrounding trees or other obstructions. In addition to the fire lookouts, everyone within or near the forests (miners, stockmen, hunters, campers, motorists) is constantly on the watch for any fires that may occur.

Fire fighters on their way to a fire, carrying their tools

Throughout the Pacific coast states, in addition to lookouts, airplanes are used to discover fires. A man in an airplane flying at 5000 to 10,000 feet above the ground can look down upon a wide expanse of country and quickly detect the smoke of a small fire which may be hidden by mountains or forests from the lookout men. The airplane, however, does not fly daily over the forest. It is used largely as a scout for making air surveys of large fires that are burning, in order that the forest officers may know how best to fight them, and for forest patrol after lightning storms and during hazy or smoky weather. Under such conditions the airplane is a valuable aid in forest protection.

At the side of the lookout in the tower mentioned in the first paragraph, stands a telephone, one of the nerve ends of the efficient system of telephone communication lines that play such an important part in combating the fire menace in our great national and state forests. There are other instruments of the magneto type located at intervals along the forest trails and roads. These latter telephones enable the forest guards to keep in touch with the central ranger station at all times.

If the guard discovers a fire, he goes to the nearest telephone, calls the ranger station, and reports the location and the extent of the fire. Men with fire fighting equipment are immediately dispatched to the scene of action and if the fire is likely to assume large proportions, one or more fire camps may be established. Temporary telephone lines are quickly stretched between these camps and the central station so that the men engaged in fighting the fire may keep in constant touch with the supply base to report progress and order more men, food, or equipment.

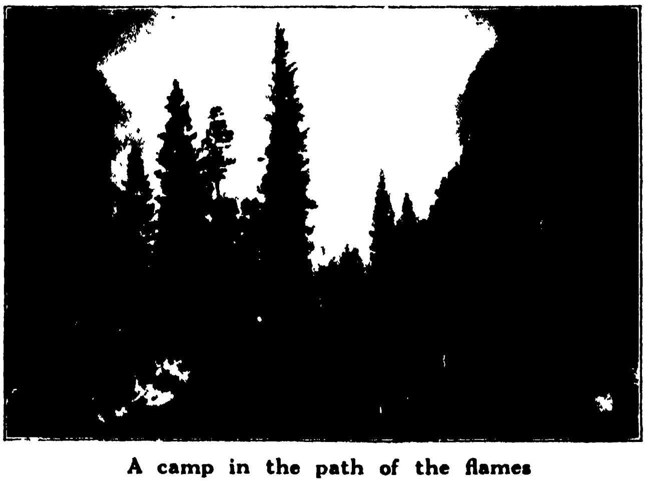
In districts where it would be impracticable to maintain a permanent fire fighting force, volunteer fire fighting units have been established under the direction of a fire leader. This man designates an individual to act as local "dispatcher" whose duty it is to take care of the lines of communication during a fire.

Fire fighting tools stored on the trail ready for future use

SINCE forest fire prevention is so largely dependent upon telephone communication, forest rangers must be efficient linemen. A course in telephone construction and maintenance is given each ranger during the training period and he is furnished with a manual giving specifications and details of telephone line construction. This construction is unique because it would be difficult to construct a pole line in thick timber, high underbrush, and rocky ground. Therefore, lines are strung along on trees, usually following trails or paths. In brush country where fire damage to wooden poles would be heavy, iron tubing is used.

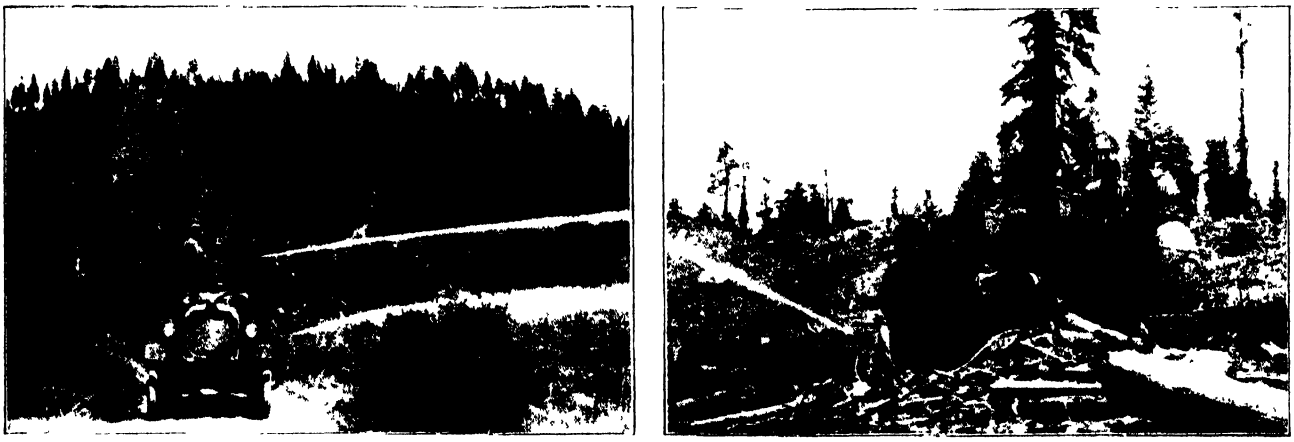
Before the beginning of the fire season a careful check is made on the communication system and the damage done by weather during the winter months is repaired. Thereafter, all lines are tested daily. Most of the forests are situated in high altitudes and the forces of nature combine to make this job of maintaining perfect communication more difficult. It is said that over 1500 telephones directly constitute the service of communication between the extensive system of forest protection in California alone.

In a few localities where there are no telephone lines, the heliograph is used. This instrument sends messages



A camp in the path of the flames

Advancing to meet the roaring enemy



A water tank on a motor truck and a railroad tank car

in telegraphic code by means of a small mirror which reflects the sun's rays. This method is therefore valueless in cloudy weather, or when the sun is obscured by the haze and smoke from a fire.

Inasmuch as weather conditions have much to do with the prevalence of forest fires, an intensive fire weather service has been in operation in California since July, 1926. The principal object of this service is to aid all fire prevention and suppression agencies in their efforts to reduce losses from forest, grass, grain, and brush fires. This fire-weather service works in close co-operation with fire-agencies, federal, state and private.

THE term "fire-weather" aptly describes those combinations of weather conditions which cause fires or which favor their rapid spread when once started. Lightning, for example, causes as high as 15 percent of all the outdoor fires in California, depending upon the season. Severe lightning concentrations in the state have caused more than 350 lightning fires in national forests during a single thunderstorm period of two and a half days.

Hot, dry, windy weather constitutes the fire-spreading phase of fire-weather. Thus a knowledge of atmospheric relative humidity, and of wind direction and velocity, have a very important bearing upon both fire prevention and fire fighting work.

The service rendered by the Weather Bureau is primarily a forecast service. Systematic fire-weather forecasts are issued by the district forecaster of the Weather Bureau at San Francisco based on the usual synoptic weather reports and charts, supplemented by daily telegraphic reports from especially established fire-weather observing stations in various areas in the state.

Airplane view of a fire in a distant canyon

The fire-weather forecasting unit which travels throughout the state of California during the fire season and gives information to aid in fighting fires

Since fires and their complex topographical surroundings cannot be taken to the district forecast center for analysis, a mobile weather bureau office has been provided to take equipment and a meteorologist to the fires. This unit consists of a motor truck equipped with meteorological instruments including anemometers, hygrothermographs, psychrometers, maximum and minimum thermometers, rain gage, and a small aneroid barometer as well as radio receiving instruments to catch the detailed weather reports which are broadcast twice daily from the naval radio station at Mare Island. The truck has accommodations for two men who will operate it, one a meteorologist in charge and the other a combination observer and radio operator.

Traveling throughout the state during the fire season, the unit proceeds immediately to a large going fire upon receipt of telegraphic orders. Radio apparatus is set up and temporary check or key weather stations are established in the fire vicinity. These stations issue detailed forecasts of all weather conditions influencing the choice of fire tactics and the ultimate control of the fire. Such forecasts are issued twice daily together with any special advice that may be required in connection with back-firing and similar operations.

PREPARATIONS for the fire season are quite elaborate. Before the season opens, an ample supply of fire fighting equipment is distributed to points where it will most likely be needed. This equipment consists of axes, shovels, rakes, hoes, canteens, cooking utensils, and emergency food rations.

During the summer months the rangers are assisted by guards, patrolmen, and firemen, but they also make arrangements with nearby merchants,

The contrast of beauty and stark ugliness of a skeleton forest made by fire: two views of the same location. Perhaps carelessness was the cause

ranchers, and others for supplies of laborers, transportation, and food in case of emergency.

When a fire is reported, the forest ranger or one of his assistants may go to it alone if it is very small. For a larger fire, three or four men with rations for two days may be sent. If the report indicates that the fire is likely to become a big one, a large number of men, with the necessary tools, are gathered and sent to the fire. Food, supplies, and further equipment follow by slower transportation because the rangers continue fighting the fire until it is completely out and do not waste time in going back and forth for food, bedding, and tools.

Small fires in grass and forest litter can often be beaten out with branches or wet sacks, but if burning fiercely it is usually necessary to clear a wide fire line which the flames cannot cross, some distance in advance of the fire. Sometimes back-firing is necessary to control big fires. In back-firing, a fire is built in advance of the main fire, usually along a road, trail, or other suitable place where it can be properly controlled; and it is allowed to burn back toward the main fire. When these two fires meet they die out for lack of further inflammable material. Since back-firing itself is dangerous if not properly handled, only experienced fire fighters should employ it.

In all fire fighting, advantage must be taken of natural conditions. A fire may burn very rapidly up steep canyon sides, but may be stopped easily at the top of the ridge. Fires usually die down during the night and the best time for fighting them is immediately after daybreak when relative humidity is high.

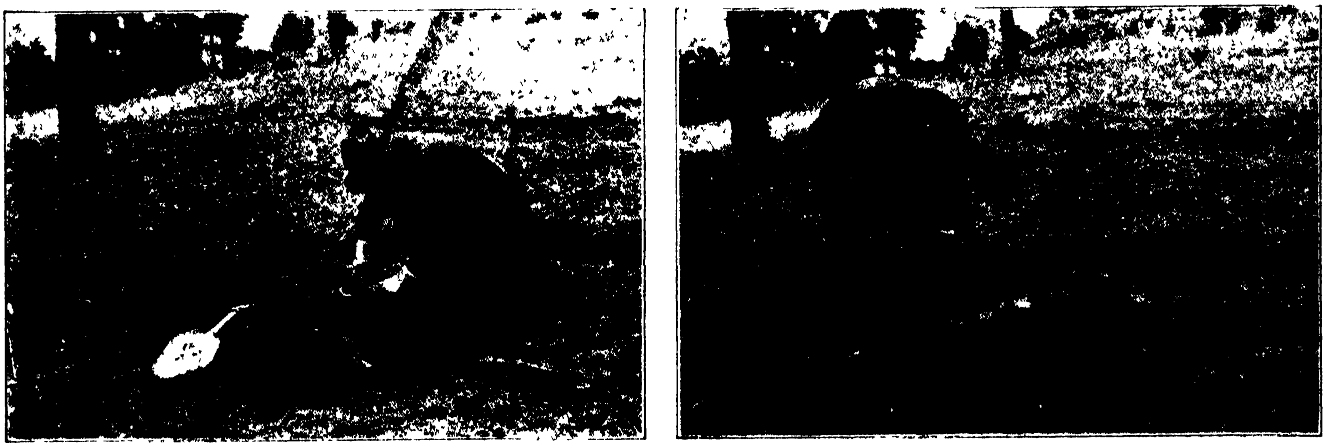
In many cases the fire-fighting equipment is supplemented by water tank pumping trucks if highways run through timber lands susceptible to fires. In many cases also, railroads have built special tank cars with necessary pumping equipment for fighting forest fires along their rights of way.

Although a large percentage of forest fires are started by lightning, a greater number are caused by the careless use of fire by tourists, campers, hunters, and fishermen. Many people know, either from actual experience or hearsay, the havoc that fires play in our forests each year; they know the necessity for precaution in using fire for any purpose in forests, but strangely, as has been noted, carelessness still seems to be the predominant characteristic of many people when they are in the woods.

Nothing betrays the tenderfoot sooner than his fire. The woodsman, before he builds a fire, clears a space of all grass, leaves, and trash, digs a small hole, and in it builds a small, quick fire. When the fire burns down he sits beside it and does his cooking. The tenderfoot, on the other hand, makes a bonfire and cooks himself while he burns his food. A woodsman never builds a fire near leafy trees, dead logs, or underbrush; nor does he build bonfires in windy weather where there is the slightest danger of the fire becoming uncontrollable.

HE never leaves camp even for a short time without first putting his fire out with plenty of water and then covering it with earth. He is always a careful smoker. He breaks his match in two pieces to make sure that it is out before he throws it away and stamps with his foot every spark in discarded pipe heels, and cigar and cigarette stubs. Many voluntarily refrain from smoking in the woods during the dry season.

Someone once said that if we could educate every American to be careful with fire, 95 percent of our national forestry problem would be solved. In closing, therefore, we shall repeat a few rules which, if followed, will aid greatly in the solution of the forest fire problem: 1, Build camp fires like those of the woodsman; 2, Be sure the camp fire is entirely out before you leave it. Be sure that matches, cigars, cigarettes, and pipe heels are out before being discarded; 3, If you discover a small fire, put it out. If it is too large for you to handle, go to the nearest telephone and notify the ranger, local dispatcher, or whomever else may be directly concerned in your particular locality and then stand by until help comes.



The woodsman is never careless with fire. He builds his campfire in a hole in the ground in the middle of a cleared space; and when he leaves, he first drenches it thoroughly with water and then covers the ashes with plenty of soil

OUR POINT OF VIEW

The Improved Patent Situation

INVENTORS who have for years been led to believe that it must take an unconscionably long time to obtain a patent, have in store for them a pleasant surprise. A keen note of optimism is now heard wherever one goes regarding the situation in the Patent Office, for things have happened there.

Admittedly, the Patent Office has had a steadily increasing file of unfinished business, patent applications that must await their turn. At the present time, it is farther behind in its work than ever, but this is partly because of the curious fact that more free-lance inventors seek patents during periods of unemployment than at any other time. But even in normal times, the majority of delays in the granting of patents are due to the fact that inventors or their attorneys exercise their statutory right to delay, for various reasons of their own, their answers to official actions of the Patent Office. The Commissioner has been diligent in his supervision and is not to be blamed when he has such conditions to face and especially when his office has been functioning under the handicaps of inadequate facilities, an inadequate examining force, and inadequate salaries for the examiners. The salary question alone has worked a great hardship on the Patent Office for years, for the examiners were never paid as much as they could command in outside practice. As a result of this, there has been a large turn-over in personnel, and new men were constantly being taken on and put through a training period that was largely unproductive.

The situation has changed. Some time ago, Congress authorized salary increases all along the line and also gave authorization to augment the force of examiners. The salary increases went into effect January 1, and the extra examiners, totaling 110 men, were on the job July 1. The examining corps now totals 708 and the total professional force 722. Members of the patent bar worked with the Patent Office for years to bring about these changes, and when final consideration was being given them, they had the unqualified support of the President, Congress, and the Budget.

An Assistant Examiner now starts at 2000 dollars yearly, a very good salary, we should say, for a man just out of college and especially in Washington where this amount is equal to 3000 dollars in most other large cities. This new man can go to 3700 dollars before he takes the next step upward to become Assistant Chief Examiner, with a fine salary increase. Then comes the Principal Examiner, head of a standard examining division of which there are 63, who now gets a larger salary than did Mr. Robertson when he became Commissioner. Still higher in the salary scale are the Assistant Commissioners and the Members of the Board of Appeals, one more of the former and three more of the latter having been included in the recent authorization to enlarge the force.

The larger force is going to improve the patent situation greatly, and the salary increase has already shown its effect in improving the *esprit de corps* of the Office to such an extent that it is felt that there will be an increasingly smaller turn-over in personnel. Besides this, further hope for the betterment of the situation is seen in the fact that within the year, the Patent Office will have moved to its larger, more modern quarters in the Department of Commerce Building, now under construction.

Sir Henry Segrave

SPEED mania has again taken its toll. This time it was Sir Henry Segrave who, piloting *Miss England II* on Lake Windermere in England, had just made a record run at over 98 miles an hour and was on a second trial run when his powerful boat swerved, somersaulted, and capsized. Sir Henry was to have entered the boat in the Harmsworth Cup races in the Detroit River August 29 to September 2

While we still do not feel that the end justifies the means in these attempts at world speed records, we do not wish to detract from Sir Henry's reputation as a man of high and dauntless courage. Those who knew him, the entire sporting world, the automotive industry for which he performed invaluable service, and many others in high places who knew him as a gentleman as well as a sportsman of the highest type, have all been shocked and saddened by his death His was the breed of daring that feared more to fail in what he set out to do than any physical hazards he had to face We offer our sincere condolences to his family and to his country

Commissioner Robertson has done much to bolster up the Patent Office and is to be commended for his part in bringing about the changes. Because of them, the Patent Office may be expected to act upon patent applications with more expedition than has heretofore been possible. In but a short time, therefore, we feel that the situation will begin to clear up; but in the meantime, we urge upon inventors a little patience, a spirit of co-operation, and promptness in replying to official communications; and upon critics of the Patent Office, more judgment in analyzing the situation.

Returning Prosperity

CURIOUSLY, last fall's stock market break did not mark the downfall of the capitalistic United States, as the small group in control of the Soviet so hopefully predicted. Of course we wouldn't think of suggesting that the prophets played too loosely with an idea—for they are very *wise*—but something happened to nullify their opinions. This capitalistic country which "bled its people dry" will soon be back at its old tricks of making and spending money and enjoying prosperity. We're sure of it!

Business has been down for an unprecedentedly long time now. An article in a bulletin of The National City Bank of New York, however, states that: "During the period of curtailed production, consumption has gone on in somewhat reduced volume, it is true, but nevertheless at a rate in excess of production so that it is only a question of time until shortages will begin to develop and necessitate the speeding up of the productive machine." In other periods of depression, the business of the country was far less diversified and lacked the recuperative power demonstrated in recent years. With the present easy money and "with the record of past depressions so suggestive of the country's ability to regain its stride, there seems reason for confidence that business will soon begin the climb back to normal prosperity."

Almost everywhere we hear the same opinion expressed, sense the same feeling of hopefulness. With everybody thus "tugging at the wheel," we are sure that boom days are not far in the offing. Perhaps our Soviet ill-wishers won't like to hear this but then, once *they* have a taste of prosperity—the success of some of their programs—doubtless they will feel less envious.

Navies and World Problems

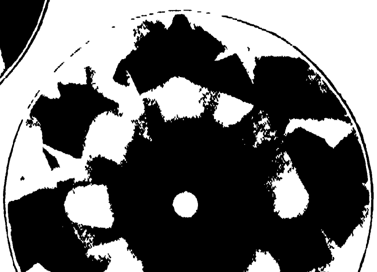
WE still believe the treaty should be ratified, in spite of the very positive handicap it places on our Navy; and we believe there would have been less opposition to it from the press and the people if the Adminis-

(*Please turn to page* 153)

Photography Identifies Gems by Their Flaws

By FRANK HEITZLER

The diamond is apt to have defects such as irregularities in cutting, incipient fractures and imperfections in crystallization, included bubbles of air or gases, and specks or flakes of metallic oxides or carbon. *Above:* photograph of a perfect stone



THE diamond is always recognized as the chief among precious stones. It is the hardest and most brilliant of minerals, but it is a curious fact that the artisan is necessary to develop nature's raw product, for there is no indication of beauty until it has been faceted and polished by the hand of man. Nature does not always give us a perfect product and, even when polished, the diamond is no exception to this rule. Ninety-six percent of the stones found are more or less marked with imperfections in their creation, and as there are no two stones exactly alike, these flaws can be used for the purpose of identification by recording them, superimposed on a photographic plate. Stones without obvious imperfections can be recognized and identified by their shape, cut, color, and weight.

Imperfections or flaws in diamonds are classified in the following way:

FIRST, there are the carbon spots which may appear as a single defect or in a group. If very fine and located toward the edge of the stone, their interference with reflection is not great, but if located toward the center of the table of the gem they will prevent the colors from striking through, and consequently will depreciate the stone.

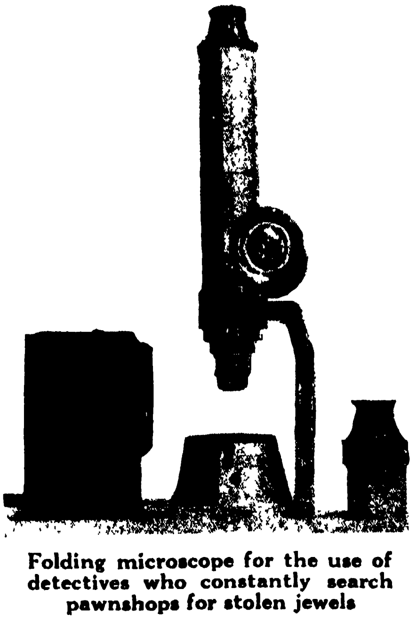
Next there are discolorations in the optical homogeneity of the stone. These may appear milky or brownish in hue, or like fine gravel. They are named "faulty structure" and are very depreciating to a stone. Another defect is the presence of bubbles; they are often filled with water or gas. As they are transparent, they do not cause any appreciable obstruction to the spectrum of colors, if not too large in size. Very fine fissures are not very detrimental, if they do not run across the table of stone, and often cannot be seen by a jeweler's glass. "Feathers" appearing on the table of a stone do not exactly improve its appearance, although they are not as detrimental as carbon spots.

Colors are ascertained through a low-powered microscope equipped with a polarizer and analyzer, intensified by a selenite plate. The operation is speedy and absolutely certain as the lens system shows the colors as they are actually present, not omitting the slightest hue. Color is the predominating factor which gives the stone its value, and it is the distinguishing favor that nature gives certain stones in their making. No cutting of facets can produce the brilliancy and wonderful display of colors imparted when rare minerals are molten in Nature's manufacture of the diamond.

It is a foregone conclussion that identification photographs of diamonds do not constitute a "beauty contest," as their purpose is to show all imperfections to the smallest detail no matter where located, as clearly as is possible with a modern scientific system of lenses. Thus it will be possible to duplicate the photographs 10 or 20 years hence, and to produce them in court as proof of ownership. In the system for identification of diamonds, the slip attached to each photograph always states size of apparatus and kind of lens used, as well as the depth of imperfections and their character.

The colors of diamonds are governing factors in obtaining a good picture. A perfectly white stone photographs an even color and the blue, greenish white, and pink tints are not so bad. However, red and yellow are two interfering colors which no filter will overcome. The reason for this is that although a filter may prevent one color from affecting the plate, the filter itself reflects back to the stone, producing another color which is usually worse than the one it prevented from coming through. In order to overcome this mixed color effect to some extent, specially prepared emulsion plates are used.

The illustrations show the equipment used; important factors are the different holders constructed so that



Folding microscope for the use of detectives who constantly search pawnshops for stolen jewels

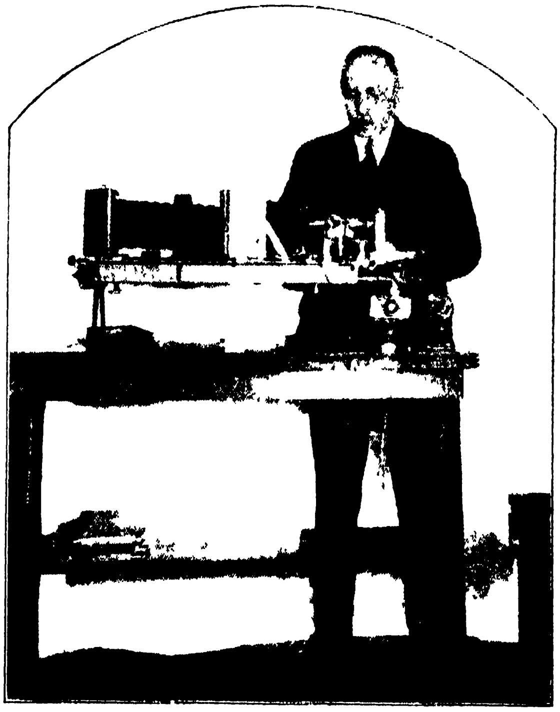
rings or stones cannot be jarred out of position while operating the apparatus. The slide which carries the lens must be a perfect fit, otherwise moving it will shift the image. The camera is of the photomicrograph type with a 42-inch bellows.

The magnification used depends entirely upon the experience of the operator. An attempt to employ too much magnification will distort the outlines of the stone, making it unsightly on account of the manifold reflections of the cut and the facets of the stone. Medium or high-power lenses are useless as the index of refraction and curve of the lens produces an interfering color. Therefore a Micro No. 1 lens is used, and the stone is inserted in the holder, after cleaning it carefully. The lens is then focused and the image appears. The back of the camera is provided with a mask having a circular opening about 3½ inches in diameter, which is placed very close to the plate. The image of the stone has to be centered by simple mechanical movements so that it fits perfectly in the mask. This is all done from the back of the camera where the operator is seated.

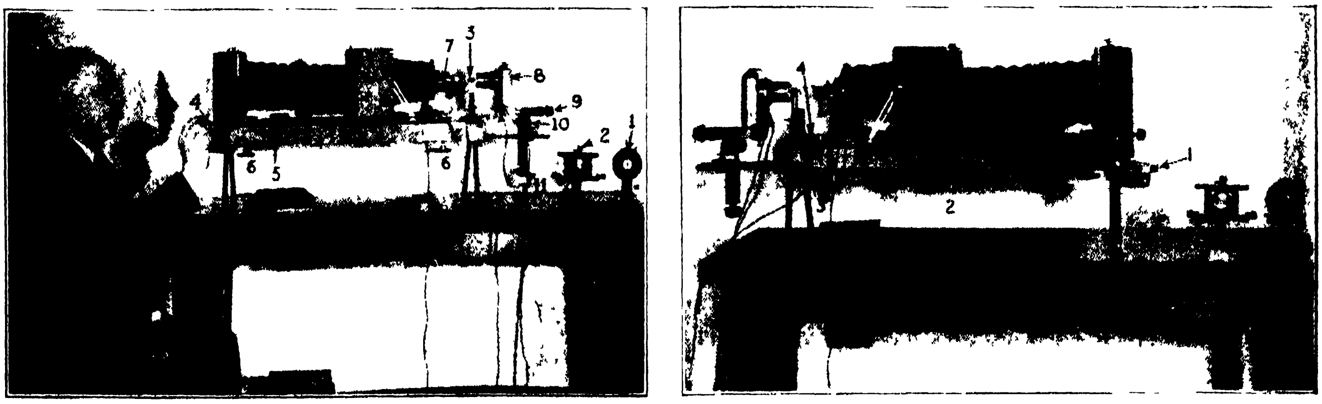
To eliminate differences in exposure due to changing daylight and to take pictures at any time, a constant-intensity electric light is used, operated by a 6- to 8-volt source. The lamp is placed in back of the stone. The condenser lens and reflector are made in such a manner as to keep the rays of light from the lens proper, confining the pencil of light to the diamond. For rubies, sapphires, and emeralds, two lamps are placed in front of the stone to give the darker stones the proper illumination. The same method is also used for settings which have no back opening or insufficient space. The time of exposure for mounted stones is from 6 to 10 seconds, and for loose stones, from 2 to 3 seconds.

After the gem is securely mounted, and the lamp turned on, the next operation is to set the micrometer to zero. This micrometer is an important feature, and is attached on the back of the camera. A rod connects the lens slide and the micrometer. The lens focuses sharply on the table of the stone, the hand of the micrometer reads zero, and the search for characteristic imperfections begins. The lens is moved toward the interior of the stone, and the depth of any flaws appearing in a certain plane is read off on the micrometer and noted. This searching is continued until the end of the stone is sharply defined. Turning backwards to the table, focusing sharp, the plate is inserted. The first exposure is of the table; second, the first imperfections as indicated by the micrometer reading. If a third exposure is necessary, all three are superimposed on the same plate.

After prints have been made, a written record is attached for further reference, the negative and the record are numbered and filed, and in case of theft, prints are made and distributed to police, jewelers, and pawn shops. If a very valuable stone, the photograph can be radiographed to foreign countries thus quickly closing to the thief all possible markets for his ill-gotten treasure.


The photomicrographic apparatus in the author's laboratory used to examine gems

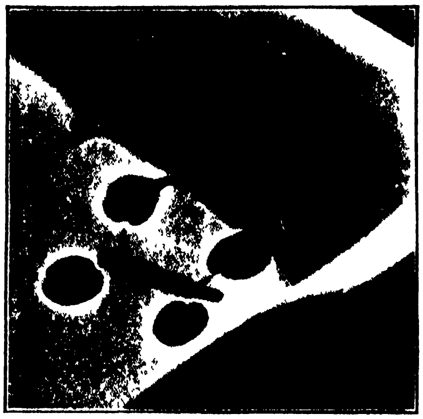
This laboratory is filled with interesting apparatus for the examination of diamonds and other precious stones by the means described in the article



Where the stones are focused and the readings taken. After the gem is securely mounted and the lamp turned on the micrometer is set at zero and the search for imperfections begins. In the left-hand illustration *1* is the holder for loose stones; *2* and *3* are holders for rings; *4* is the lateral adjustment for holder; *5* is the focusing arrangement; *6* is the device for raising and lowering lens; *7* and *8* are lamps; *9* the condenser adjustment; *10* and *11*, adjustments for light. In the right-hand illustration is the back view. *1* is the micrometer; *2* is the connecting rod; *3* the lever arrangement; and *4* the connecting pin to lens slide

Walking On Water

By HENRY J. TOMLINSON, B.Sc.



Illustrations by the author

A little artificial water skipper made of a match stick, with tiny wire legs waxed at the bottom, will float on the surface of water

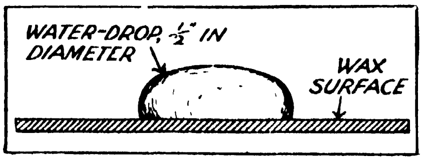
IF we stroll in the country by a pond on a summer's day, the chances are we shall see insects moving on its surface; some of them, such as whirligig beetles, are swimming, but others, for example the so-called water skippers or pond-skaters, are actually walking on the water. This is in itself a most interesting thing, but there is something else well worthy of attention.

If the sun be shining brightly, a number of little shadows will be seen on the bottom of the pond. Each of these corresponds to a foot of a water skipper, or some other insect walking on the water surface. Each is surrounded by a narrow, bright halo of light, reminding one of a tiny dark cloud with a silver lining. At the top is a photograph showing such shadows, together with their halos. How comes it that some insects can walk on water, and what is the explanation of the beautiful little shadows and their attendant halos? When a liquid is brought into contact with a solid, the liquid in certain cases is said to "wet" the solid, while in others it is said not to do so. To the non-scientific mind this would seem strange, as naturally one would expect a solid to be wetted when in contact with any liquid. It is, of course, all a matter of definition, and a simple experiment will make the point quite clear.

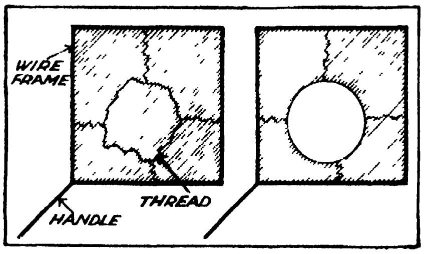
LET a drop of water be placed on a horizontal sheet of glass which has been cleaned and repeatedly scrubbed with nitric acid, and is perfectly free from grease. It will be found that the water spreads in all directions over the glass. Now let the glass be coated with a thin layer of melted candle-wax which is allowed to solidify. If a small quantity of water be placed on the solid wax surface it will not spread as in the previous case, but will gather up into a drop, the shape of which depends on the quantity of water taken; one such drop is shown at the right. The clean glass surface is wetted but the wax surface is not wetted by the water, in the scientific sense. In the same sense, the clean glass surface is not wetted by mercury since the latter, when placed on it, collects into drops.

The surface layer of every liquid behaves in many, though not all, ways as if it were a very thin *stretched* elastic skin; that is, an elastic skin under tension. Of course, the surface layer does not differ in chemical properties from the rest of the liquid, but it behaves in a different way.

A very thin, stretched, horizontal sheet of rubber will serve as a rough model indicating the behavior of the surface "skin" of any liquid. One property of the stretched rubber sheet is its tendency to shrink again, and it is evident that it will do so if the stretching force be removed. The following experiment shows that a liquid surface has the same tendency.



A drop of water on the waxed surface of glass remains heaped up



An interesting experiment made with silk threads and soapy water

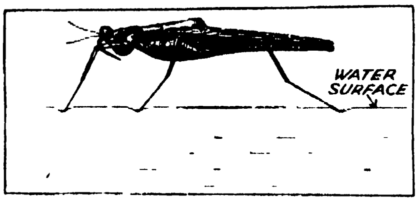
Above, at the left, is represented a wire frame to which a loop of very fine unspun silk has been attached, by means of four tethering threads of the same material. If the frame be dipped into soap-solution, such as is used for blowing bubbles, and then removed, it will be found to have a soap film stretched over it, indicated in the figure by the shading. In this film the silk loop floats. The film has two surfaces, just as a sheet of paper has, and each surface is tending to shrink. If now the portion of the film *inside the loop only* be broken by touching it with the end of a hot wire, the remaining film will pull the loop into the form of a true circle, as shown at the right. The reason is that the remaining film shrinks to its smallest possible dimensions, and in doing so it obviously pulls the loop into that shape for which the area inside it is the greatest possible the circular one.

Returning now to the model of the stretched rubber sheet, imagine a mouse to be walking on it. The rubber will sag under the feet of the mouse, just as a tight-rope sags under the performer. In a similar way, the surface "skin" of water sags under the feet of a water skipper. In fact a tiny hollow or dimple is made in the surface under each foot, as indicated in the drawing below (not intended to be accurate in detail), and this sagging enables the weight of the insect to be supported.

IT is absolutely necessary that the nature of the insect's feet should be such that they are not wetted by water, for if they were the water would spread over them. In this case, the feet would go through the surface layer and walking on it would be impossible.

Another figure shows, on an enlarged scale, how one of the dimples mentioned can be used to explain the formation of the shadows and halos on the bottom of the pond. The black object indicates the insect's foot. For simplicity it is drawn as a vertical stump, after the manner of a wooden leg. Also for simplicity, all the rays of light falling on the water, represented by lines with arrow heads on them, are taken as being perpendicular to the undisturbed surface of the pond.

When a ray of light, for example *AB*, strikes the water surface perpendicularly, it passes into the water without any bending or deviation. But when it strikes the surface obliquely, as in the case of the ray *CD*, it is bent on entering the water and takes the path *DE*. The amount of bending depends on the magnitude of the angle which the ray makes with the surface, and if the paths of the various bent rays to the left of the central line *FG* be traced, it will be found that they are all tangential to a certain curve *HJK;* an exactly similar and symmetrical arrangement holds good for the bent rays to the right of *FG*.



The skin or surface film on water sags under the weight of the insect

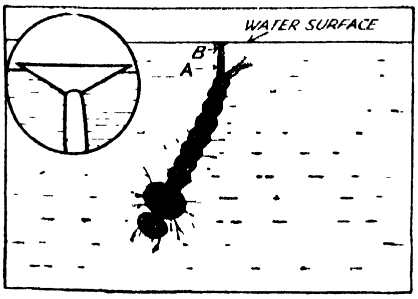
Now let the bottom of the pond be represented by the line *LM*, and consider the narrow beam of light *NP*, which is shaded in the figure. It will be seen that this beam, after entering the water, comes to a focus at the point *J*. Consequently *J* is a bright point on the bottom of the pond, and, for the same reason, *Q* is a bright point too. No light rays fall on the bottom of the pond between the points *J* and *Q*. Therefore all points between *J* and *Q* are dark; in fact *JQ* corresponds to the shadow.

As the figure shows only the rays in the plane of the paper, it is necessary, in order to obtain the explanation of what occurs in nature, to imagine the figure to revolve about the line *FG* as an axis. The bright points *J* and *Q* then travel 'round a circle so that, when we take into account all possible rays and not merely those in the plane of the paper, we see that there is a bright circle on the bottom of the pond. This is the halo to the dark circular shadow of diameter *JQ*. The rest of the bottom of the pond, illuminated by such rays as *AB*, is bright, but not so bright as the halo, owing to absence of focusing of the rays.

IT is interesting to observe that the diameter *JQ* of the shadow is greater than that of the stump representing the insect's foot. Also, if we imagine the bottom of the pond to be transferred to the level of the line *RS*, so that the water is now deeper than before, the halo will be produced by such beams of light as *TW*, which comes to a focus at *K*, the diameter of the shadow being *KY*, and therefore greater than in the previous case. Thus the deeper the pond, within limits, the greater is the size of the shadow.

In nature the shadows are not circular, but of an irregular oval form, owing to the shape of an insect's foot differing from that of the stump shown in the figure.

No doubt many readers will like to know how to produce the shadows artificially by means of a little model which takes the place of the living insect. This model, which is made from a match-stick and very thin wire, is shown at the right, its total height being about three eighths of an inch. To prevent the wire feet from being wetted by water, they must be coated with little masses of wax.



How mosquito larvae breathe. Inset: magnified breathing tube

The model will stand on water, provided it has the dimensions given, and if the bottom of the containing vessel be white, it will show very clearly the shadows and their halos when a bright source of light such as an electric lamp (in the absence of sunlight) is placed directly above it. One figure shows the corner of a white dish containing water, in which air bubbles can plainly be seen. The model, with body blackened, is standing on the water.

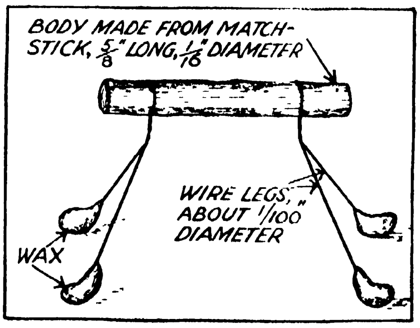
As wax floats on water, it may be thought that the wood and wire are buoyed up by the little masses of wax and that therefore the weight of the model is not supported by the water skin; in other words, that the model is not really standing on the water. Any doubt on this point can be removed by completely immersing the model, when it will be found to sink.

So far, we have considered insects moving on the upper side of the "surface" skin of water, but pond-snails can hang from, and crawl on, its underside, somewhat in the same way as a fly can walk on a ceiling.

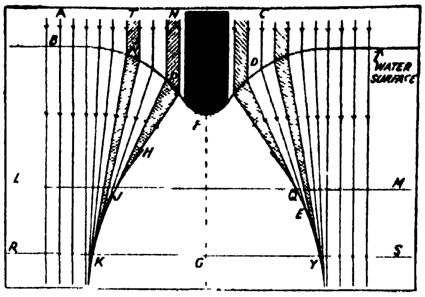
The power of hanging from the surface layer is of great importance to mosquitoes. These insects in their larval stage, which corresponds to the caterpillar stage of a butterfly, live in water and can be found in summer in almost any place where water collects.

A drawing of the curious looking larva of one species of mosquito is shown enlarged below at left. The side tube *A* is used for breathing purposes and five little plates are hinged to the end of it at B. When the larva is wriggling through the water, these plates are brought together, so as to form a kind of conical lid to the end of the tube, thus preventing the water from entering. But when the larva needs air, it rises to the surface, pushes the end of the tube through it, and then splays the little plates outwards, so that they form a kind of miniature funnel (indicated in the figure), by means of which the larva hangs from the surface "skin." Air, but not water, now enters the tube, and in this way the larva breathes, much like a diver.

Now the strength of the surface "skin" differs with different liquids and, in addition, the strength of the skin of any liquid is altered by contamination. It so happens that the skin of kerosene oil is weaker than that of water and the skin of water is therefore weakened by being contaminated with kerosene. Hence, if kerosene be poured on a pond in which mosquito larva are living, the surface is no longer able to support their weight when they attempt to hang from it, and they can not take in air through the breathing tubes. The kerosene not only cuts off the normal supply of air, but also gets into the breathing tubes and chokes them, so that the larvae die.


BODY MADE FROM MATCH-STICK, 5/8" LONG, 1/16" DIAMETER
WIRE LEGS, ABOUT 1/100" DIAMETER
WAX

How the synthetic water skipper described in the article is made



The sag on the surface film makes a negative lens, causing a shadow

THIS method of killing the larvae has been successfully used to reduce very considerably the number of mosquitoes in those regions where, at one time, they were a pest, acting as carriers of the germs of malaria.

The surface film of water is only one example of the many existing phenomena of capillarity and surface tension in liquids. These form a fascinating chapter in the modern science of physics, from which a wealth of fact concerning the size and shape of molecules has been revealed, and there is a large though mainly technical literature on them.

Numerous examples of surface tension and other capillary phenomena exist. A familiar one is exhibited when we wash our hands with soap. Though soap is a chemical, based on stearic or some related acid, it has been learned within recent years that its main work is not done chemically but physically; the molecules crowd around and work beneath the dirt particles, actually shouldering them off by reason of the strong capillary forces they exhibit.

Soap bubbles, too, may be used in many interesting ways to display the laws regulating surface tension; some of these have been described, rather technically it is true, by A. S. C. Lawrence, former assistant to Sir James Dewar, in his recent book "Soap Films"; while the earlier researches of Dewar himself on soap films are widely known. The English physicist C. V. Boys also has written accounts of numerous related experiments. In short, the whole subject of surface tension and capillarity provides endless interest.

The normally small Des Peres River flowed behind the houses at the left. This photograph was taken during the flood of 1928. The great flood of 1915, however, reached nearly to the tops of the street lamp posts at this point

St. Louis Buries a River

By W. W. HORNER

Chief Engineer, Sewers and Paving

THERE is now being constructed in St. Louis a municipal drainage project on a somewhat larger scale than anything American cities have heretofore undertaken. The River Des Peres in St. Louis is, or was, a creek draining a basin of about 110 square miles. It flowed through St. Louis' best residence district, through the great Forest Park, through a heavily used industrial area, and, finally, across six miles of a developing semi-suburban district to discharge into the Mississippi River in Carondelet.

As the city has grown into this valley, sewers have been constructed discharging into the stream; as early as 1905 it had become an open sewer. Then, too, the great increase in the coverage of the permeable soil, which came about through paving and building, increased the runoff of storm waters so that the flooding of the lowlands occurred yearly with increasing severity.

The city discussed improved drainage along this stream for years but no administration was able to secure the necessary funds. Then in 1915, as an offshoot of a Gulf hurricane, a rain of over 10 inches occurred on this watershed in 20 hours. The resulting flood produced high-water marks many feet higher than any previous record; it isolated sections of the city, stopped operations on trunk-line railroads for as long as two days, and caused a serious loss of life. Thus the problem assumed alarming proportions.

Thereafter the carrying out of an improved drainage plan was a major issue in municipal affairs. Preliminary attempts to secure the funds failed but the matter was kept alive, and in 1923 a fund of 11,000,000 dollars was made available as part of the 87,000,000-dollar municipal improvement bond issue of that year.

IN the meantime sufficient funds had been available to permit surveys and detailed engineering studies to proceed, and in 1916 under the instructions of Hon. E. R. Kinsey, President of the Board of Public Service, a definite plan of improvement was worked out by the writer and adopted by the Board. This plan has been elaborated and revised, but is essentially the scheme on which the present construction is being carried out.

At the upper end of the project the river is taken into a 32-foot reinforced concrete sewer which extends for two miles to a point in Forest Park where it is enlarged to a double 29-foot concrete sewer and continues for another two miles. Below this point the drainage area is much larger and the cost of the complete "burying" or enclosing of the river would have been too great. A different plan was, therefore, adopted for the remaining nine miles to the Mississippi River, consisting of an open floodway for storm drainage and an underlying sanitary intercepting sewer.

At this time, three of the four miles of concrete sewer have been completed and the last is under contract. The central three miles of channel and sewer are complete and in service, while nearly all of the channel work for the lower six miles is under contract or has been partly completed. The whole project is scheduled for completion at the end of 1931. When finished, it will have substituted 13 miles of closed sewer and rectified channel for about 18 miles of the old natural tortuous river bed.

Two phases of this work must be of unusual interest to technically minded readers. The first of these involves the engineering studies underlying the design of the system and the more recent tests by which some of these are being checked, and the second the construction approach to the project which involved an unusual choice of tools and an organization of the work to be carried out under recurring flood hazards.

The radical difference in the character of the plan, as between the upper and the lower valley, was due to a combination of surrounding circumstances. The plan for the upper valley involves the unusually large combined sewers, 32-foot and double 29-foot in size. The adoption of this type of plan was the result in part of the restricted conditions north of Forest Park, where residential and industrial development had encroached so closely on the creek banks that there was no room to maintain a flood channel of proper size unless arranged by the acquisition of very expensive lands. Then, too, the river could be completely inclosed in combined sewers at an expense within the limits that the people were willing to consider. Finally, the city had had to live so closely in conjunction with the unsanitary stream flow and continually recurring floods, that the popular irritation with the situation had passed ordinary limits, and no improvement would have been satisfactory which would not have removed these old sores completely from the surface.

IN the lower valley, each of these considerations was reversed. There was in most instances room to construct ample floodways on land that could be acquired at moderate cost, while the expense of complete enclosures of sufficient size to carry the great floods from the larger drainage basin would have involved costs many millions more than had ever been considered. Finally, this section of the city was not densely populated and, except in parts of the upper three miles, the flood damages and the nuisance factor had not injured a great number of people.

With the adopted plan definitely fixed, the first important factor and the most significant to the whole scheme was that which would fix the amount of flood water for which the works would be designed.

In sewer design, the question of rainfall and flood frequency has been extensively studied and engineers in different cities have adopted a variety of answers to the economic question. In general, city sewers are designed for such an amount of water that they are expected to be overcharged at frequencies of once in 15 years, under conservative policies, down to an average of once in one or two years where lower property values do not justify the greater expense.

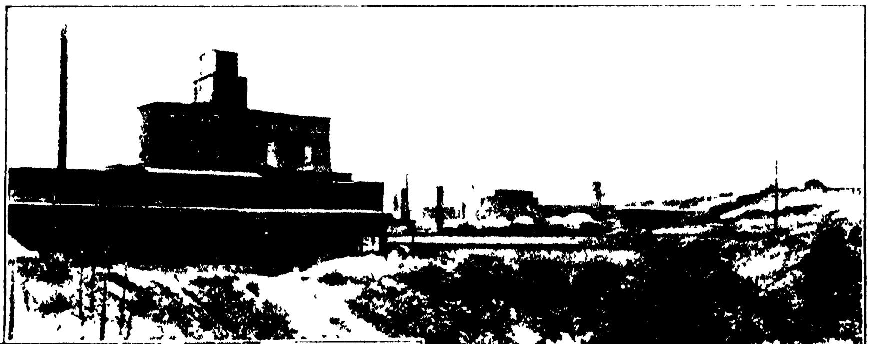
In the instance we have here, it was decided that the capacity of the River Des Peres works should be such as to care for any flood likely to occur once in 15 or 20 years, a slightly more ample basis than that used for smaller sewers. Obviously the determination of the volume of such a flood is not susceptible to exact analysis nor is there available any great amount of data of good character from which the answer can be worked out.

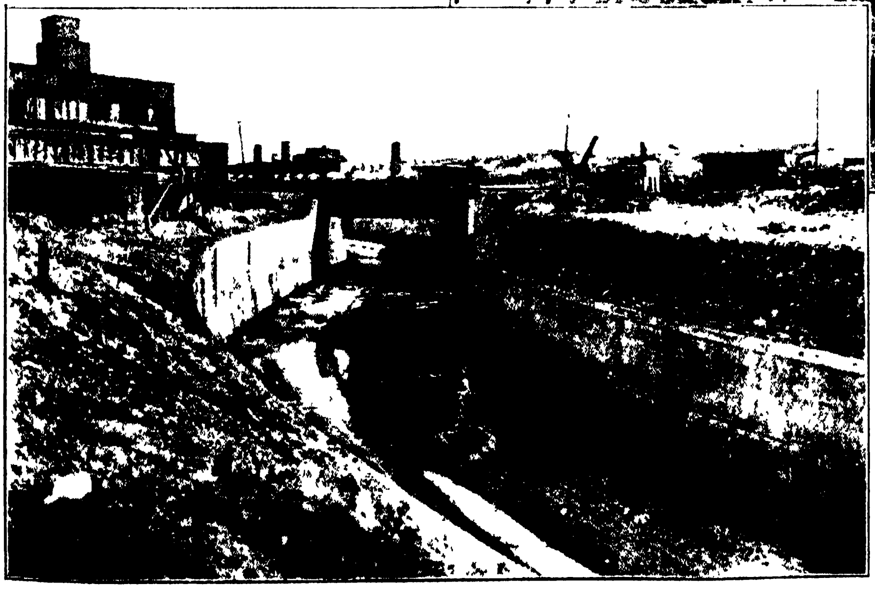
The figures of the amount of water per second for which provision must be made are very interesting, as showing what really terrific floods can come from small valleys with good slopes if the surface is not permeable. It is particularly surprising that the high-water flood of this little 110-square-mile valley may actually be greater than the low-water flow of the Mississippi River as it passes the city of St. Louis.

The size of sewers required on this project required us to use arches that are in a peculiar class. They are greater than the sewers originally involved in the city system and are smaller and of a different type from those ordinarily entering into concrete bridge design. Consequently there was little precedent for the engineering work to be done on them. It is not commonly known, outside the group of specialists who deal with this problem, that one of the dark spots in engineering knowledge is concerned with the pressures which earth places against such structures at the backs of retaining walls and the buried tops and sides of sewers and culverts.

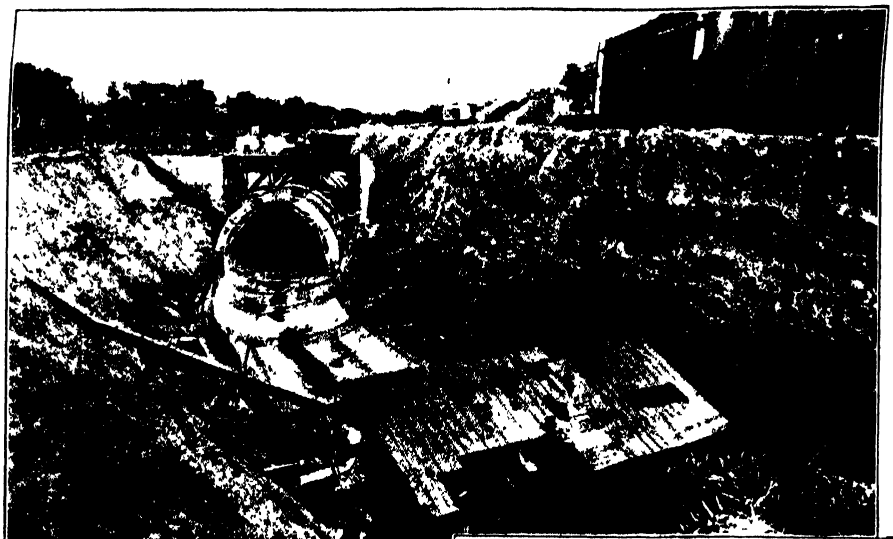
ONLY in the last 20 years has any really scientific work been done in this field and most of this has been to determine the earth loads coming on small sewers either in narrow trenches or on culverts under highway fills. The result of this research work on small sewers was of some value in choosing the loads for which the Des Peres arches were to be designed, but the factors which the research had produced had to be exterpolated to such an extent as to be somewhat unsatisfying.

The arches are of reinforced concrete. The stresses were determined by an application of the elastic theory of arch design, the thicknesses were proportioned by an assumption that the compressive stress in the concrete





The change brought about by the improvement at a point east of Knox Avenue. The illustration above shows the undisturbed condition of the old river bed, and that at the left shows the completed work at the same point. It was necessary to demolish the concrete arch bridge of the Frisco Railroad and replace it with the steel structure shown at left



The single 32-foot sewer in process of construction in front of the Jefferson Memorial Building

would not exceed 800 pounds to the square inch and the tension from the steel bars would not exceed 22,000 pounds to the square inch.

It was critical to the progress of the work that the great steel centers on which the concrete was poured should be loosened and moved ahead for reuse as quickly as possible. It was decided that this support could be removed whenever the strength of the concrete reached 1200 pounds per square inch, and to determine this time, standard test cylinders were prepared out of the concrete as it was poured into the arch.

HAVING had to design these structures without as much satisfactory fundamental data as was desired, we felt it to be part of our duty to develop some of this data on this project for use in future structures. Accordingly a complete series of tests was developed in an effort to determine what the actual earth loads are and what the pressures under the footings are by building into the sewer a large number of Goldbeck pressure cells. These cells are interesting little machines in which the pressure of the earth against the face of a diaphragm is weighed by balancing this pressure with air pressure introduced behind the diaphragm. When the air pressure exceeds the earth pressure, a slight movement takes place, electrical contact is broken and the pressure may be read on an air gage.

Readings of earth pressures were begun as soon as the fresh backfill was placed over the sewer in September, 1928, and have been continued. It is very interesting to find that the actual measured pressures on the tops of the arches at the present time are equal to 50 percent more than the actual weight of the earth over these points would cause. One would be doubtful of the correctness of this result had not a similar condition developed on certain culvert tests made elsewhere. It appears that this is possibly because the settlement at the bottom of the deep fills on each side of the arches leaves the upper part of the fills relatively unsupported. A shearing stress is developed in the soil which transmits a part of the weight of the earth at one side of the arch on to the arch proper. This possibility was not realized at the time the arches were designed and it is fortunate that a large factor of safety has been provided.

The horizontal pressures are quite close to the assumptions used in the design, but we can see that these might not be true if the sewer had been constructed in the narrow trench instead of in a wide sloping cut.

The reactions under the footing are very peculiar. They seem to indicate that the inverted arch is supporting the center wall almost free of the ground, but we do not dare adopt this assumption, as some of the soil pressure cells occasionally fail to record when placed on shale or fireclay of hard quality as was the case here. This condition of reaction, however, is not impossible and leads to some interesting speculations.

The double 29-foot sewer. In the right foreground is the 300-ton shovel with which the main excavation was done. Its arm has a reach of 90 feet

The construction of the drainage works has been under way since 1924, when the first of the open channels was started. From the very beginning it involved unusual features not common in municipal sewerage.

As the new works lay in the valley and the site was closely restricted by both residential and industrial developments, a great part of the open channel and low level sanitary sewer had to be built in the creek bed or in such a way as to be continually crossing the creek. Construction operations were accordingly at the mercy of the weather and were subject to sudden interruptions by freshets which would sweep over the site and cover the equipment.

It soon became apparent that the success of the operation must lie in so over-equipping the job both as to capacity of the machines and as to the power used, that great progress could be made in the short periods between the rains. This led to the use of large draglines kept as far as possible out of the creek beds, assisted by small equipment in the stream to do the final trimming, this last equipment of a type that would not be seriously injured by continual immersion. In spite of the careful choice of equipment in this way, the work executed under such flood hazards was necessarily very expensive and proceeded somewhat more slowly than was expected when the project was first started.

Whatever loss of time and unusual cost entered into the first three miles of open channel was about balanced by the great savings which it was found could be introduced into the quantity production methods used on the construction of the big concrete sewers. These contracts, like the earlier ones, were equipped with extremely large and powerful excavating units. The high cost of having the work flooded was learned early in the progress and thereafter considerable expenditures to protect the site from floods yielded good returns.

Concrete for most of the work has been manufactured in central station plants of large capacity, completely equipped with machine handling devices and automatic controls of materials and of water. It was hauled to the site of the work in one case by industrial trains and in another in dump trucks. These central concrete plants not only proved to be very effective in lessening the cost of the product but were extremely valuable in producing uniformly well-proportioned mixtures. This last result was brought about not only through the efficiency of the mechanical control apparatus but also through the necessity of securing the result, as the concrete not so accurately proportioned was not subject to long haul without segregation.

The value of these quantity production methods and of protecting the work from interruption by floods is shown by the progress records actually attained. In the month of September, 1929, each of the contractors produced 30 units of sewer on 30 consecutive days. As these units were either 30 or 35 feet in length, nearly 1000 feet of sewer were built on contract that month.

Where the last contract of the big 32-foot sewer is just now being started, most of the construction must take place in a narrow gorge through which the river runs, as there is very little working room on either side. The contractor here, Stiers Brothers, has developed a totally different type of equipment consisting of duplicate electrically-driven tramways of about 1800-foot spans to haul the material in and out, and small shovels and draglines in the river bed loading skips.

ONE of the things that every worker in the ground has come to fear is the encountering of wet running soils, sometimes called muck, sometimes quicksand, depending on the amount of clay present. It has almost gotten to be a tradition among sewer contractors that when quicksand is encountered, all ordinary plans must be abandoned and enormous costs are involved in holding back the running earth with sheet piling, timber, and other effective barriers.

In recent years engineers and the more understanding operators have learned that this material is essentially the same as any other soil except for the presence of an excessive amount of water, sometimes under pressure. Systems have been devised for removing this water through pipes driven into the ground and, where the sands are sufficiently coarse, stable soils are produced.

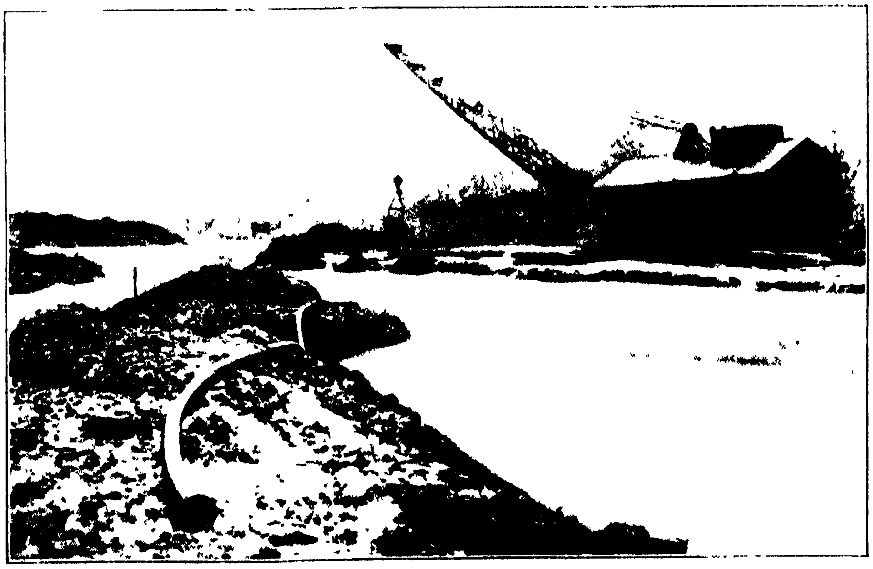
A very interesting problem of this general kind entered into the building of the Des Peres works. This problem arose because the new improvements were to give the same standards of drainage as did the city sewer system and accordingly these works must carry the floods at levels of eight feet or more below the improved ground surface. With the flood water levels so fixed, the bottoms of the channels or sewers were at a great depth below the old creek bed, sometimes as much as 25 feet.

When work on these deep excavations was started in the middle of the natural valleys, the first operation was to open a hole or excavation to the new depth. The natural result of this was that all the soil moisture in the surrounding area tended to flow to the low level outlet. In passing through the soil adjacent to the trench, the pores of the soil were filled under pressure, instability resulted and there was a continual tendency for the banks of the excavation to slide or slough in.

At the beginning of the work, this condition horrified the operators and they were quite sure for a time that the low level structure could never be built, or, if built, that the banks would be continually sliding and that the concrete or rip rap paving laid on the banks would be crumpled up and demolished. They advised, instead, that heavy reinforced linings be placed capable of holding back the terrific soil pressure. A small amount of such lining was actually placed as an example only, for we were convinced that the soil would become stable once the excess moisture had drained out and the pressure of the water in the pores was relieved. Accordingly, we arranged for the rough excavation to proceed and for the trimming of the banks and the placing of the lining to be deferred. A slow outseeping of moisture followed, the ground water level in the valley was gradually lowered and within six months after the original excavation the banks had become re-stabilized throughout. Of the first 30,000 feet of channel bank so treated only 300 feet gave trouble after completion and that was at a point where the bank had been supercharged with a fill of wet clay.

So effective was this means of securing stable soil by natural seepage that when one section had to be started without an outlet, it was decided to simulate this condition artificially. Six months before the beginning of the work a pumping well was sunk to the level of the proposed excavation, drain tiles were run out along the site of the work for several hundred feet and the ground water was continually pumped until the time the work began. When the big machines actually arrived and the new cut was opened the soil was found to be quite stable and no difficulty whatever arose. It was further found that once a stable condition of this sort was created, the soil moisture would drain effectively to the excavation at about the rate at which the work was able to progress up the valley so that difficulties of this kind only occurred where a new depression was opened.

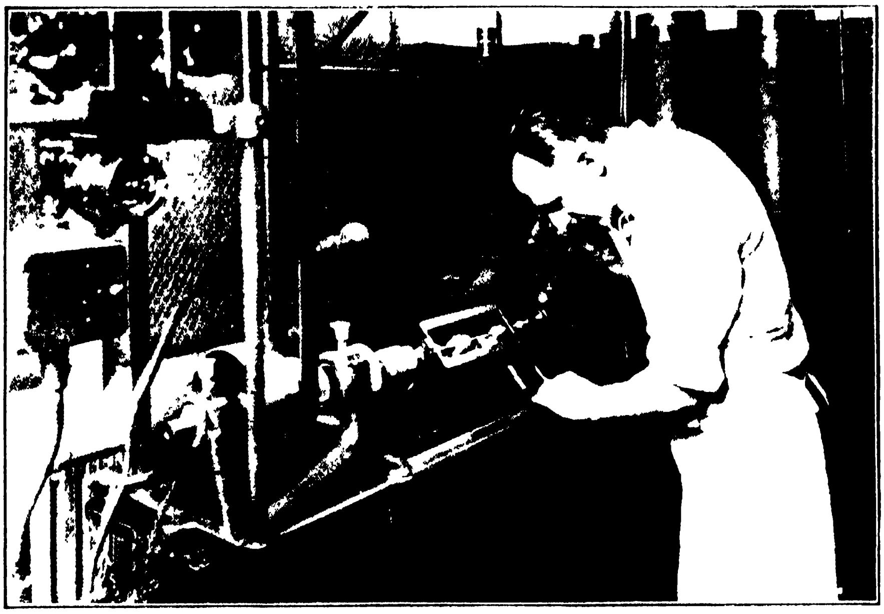
SEWER construction has for a long time been in the hands of practical men who have been accustomed to fight their way out of difficulties and it is very interesting to find how often an adaptation of some relatively simple law of science can make easy the progress of work of this kind.



A section of the job showing one of the heavier floods passing over the construction work. The crests of these floods usually were of a few hours' duration

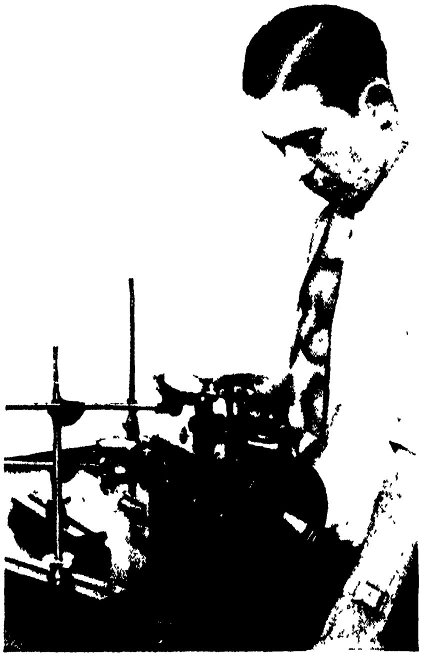
Checking parallelism of film sprocket faces. Microscopic measurements are made of all of the parts

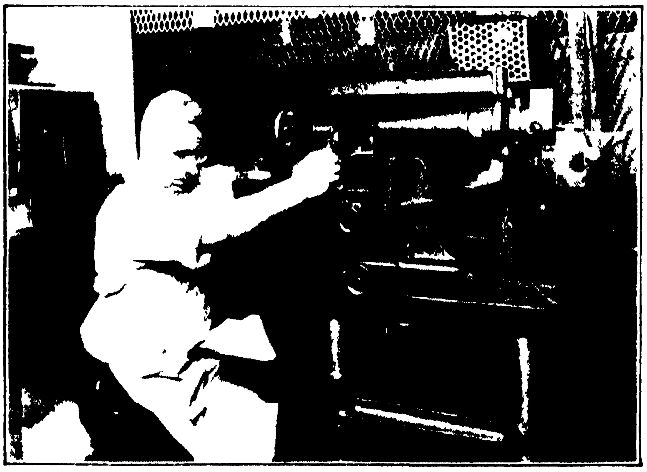
An optical system being adjusted. A highly accurate beam of light is required for film reproduction



The main drive on the base of a universal projector consists of three sets of bevel gears with the drive gears on a single shaft. These all must be quiet when in operation

Right: The gears in a motion-picture projector must run without back-lash. After the machine has been run, the gears are checked for back-lash and bearing clearance



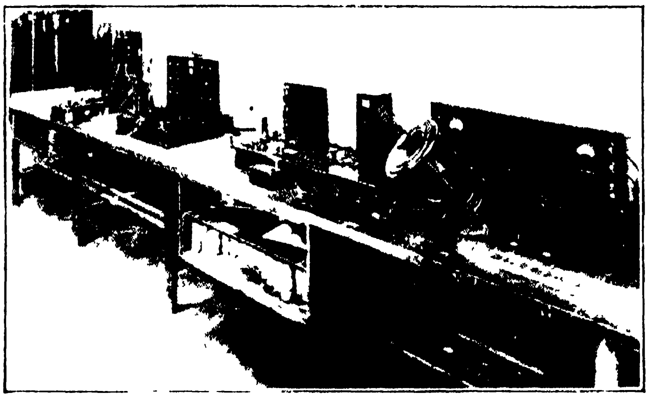


The adjustable film aperture must be accurately made so that its image on the screen, enlarged over 200 times, will show no defects. *Above:* Checking aperture

A main drive unit has been assembled and run in. Before it is shipped to the theater, it must be tested once more. The operator is listening for tell-tale noises

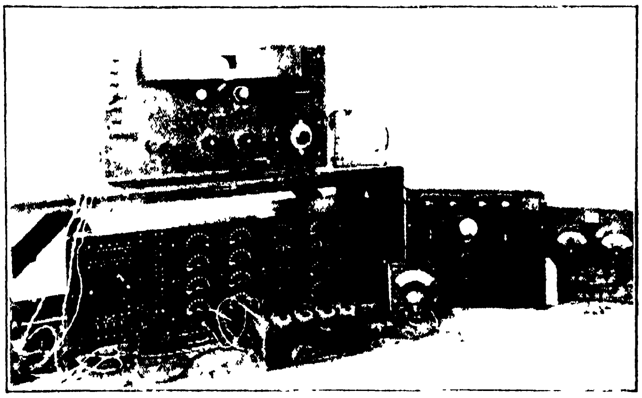
The electro-magnetic reproducer for disks is tested for operation

An "electric ear" is placed on the record turn-table as it whirls around on the test bench. A sensitive meter tells the operator of any noise-making faults



All photographs courtesy Western Electric Company

On this elaborate test table, the transformers of the amplifiers are tested for their electrical characteristics



The assembled amplifiers are subjected to tests more rigorous than actual operating conditions in theaters

Accuracy In 'Talkie' Equipment

ACCEPTANCE of talking motion pictures as a permanent part of the entertainment field has imposed on the manufacturers of motion-picture projectors a standard for their mechanical work that rivals that set by the makers of the finest watches. Not only must the machine project perfect motion pictures, but it must also be the source of accurately synchronized sound and voice effects.

It is doubtful if there is any other delicate machine of which more is required than a motion-picture reproducer. It must be rugged enough in construction to stand the rough usage and steady grind of every-day operation, yet parts of it must be so delicately constructed that they can handle without distortion minute voice currents so small that only the most sensitive meters will measure them. A universal type of machine can transform almost microscopic marks on the film into the most delicate shadings of sound or it can be run with disk records to reproduce from tiny scratches in the grooves on the disk. At the same time, the projection mechanism must be functioning, passing the film before the aperture where it is brought to a dead standstill 24 times a second. Yet, about 14½ inches from the point where the film is started and stopped, it must be flowing smoothly past the sound-light aperture without the slightest pause or jerk.

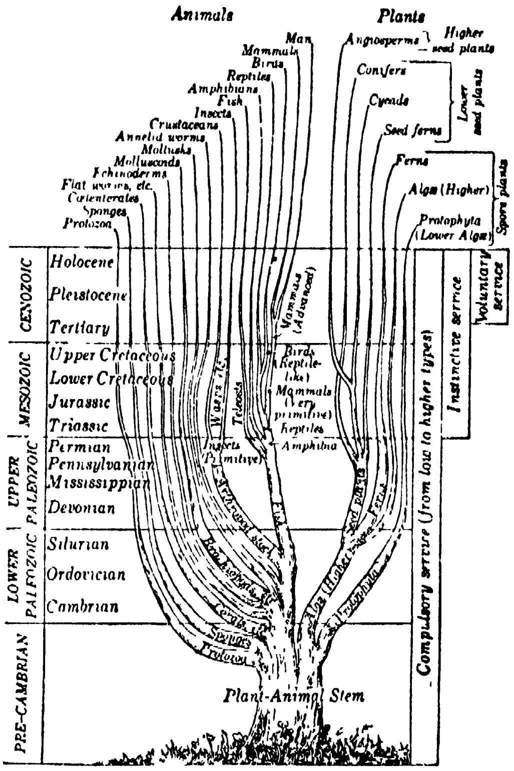
IT is small wonder, then, that the manufacture of sound-picture projectors requires a huge staff of inspectors. The machines must be so perfect when they leave the factory that, when they are installed in a theater, they will operate properly from the first turn of the switch. There can be no breaking-in period in the theater, such as the automobile owner gives his car, for the first performance of a projector is usually judged more critically than any other. Therefore the machines are carefully tested before they leave the shop, and the gear drives are run-in, under load, for periods varying up to 24 hours. This operation removes any burrs and irregularities from the gears, and insures that the final tests for noise and irregular operation will show whether all of the parts are meeting the exacting requirements of theater conditions.

In the photographs on this and the opposite pages we show some of the many intricate tests and inspections that are made before the projector is finally considered up to standard and is shipped to the theater. Here also it is constantly tested in preparation for each daily grind, to insure that the performance will go through without mechanical or electrical failure.

Zoogenesis

The New Theory of Evolution

By AUSTIN H. CLARK
United States National Museum



From Shimer's Evolution and Man Courtesy Ginn & Co.

Tree of the evolution of living forms. The lower (pre-Cambrian) part is an assumption, like some of the unbroken branches

FROM the very earliest times the absorbing mystery presented by the multitudes of different forms of animal life has attracted the attention of the studious among all human races.

We know that all living things are derived from other living things life can not arise spontaneously. So in the extremely remote past all forms of life must have had a common origin. No one with any knowledge of biology doubts this, and those with no knowledge of biology are in no position to deny it.

Every living thing is evolved from a particle of living matter a single germ cell in which no trace of the adult form of that living thing is discernible. This cell divides into two and the derivatives continue to divide until the final form cow, insect, crab, jelly-fish or something else eventually is attained.

Since every animal, no matter what it is, originates as a single cell, we are safe in saying that all types of animal life must be explained in terms of a primitive single cell.

THE course of the development of animals from a single cell to multitudes of different kinds we know today is explained by what is commonly known as the theory of evolution.

Evolution assumes the gradual development step by step of all the widely varying forms of animal life from an original form of simple structure.

But the developmental course which has been followed by animal life from its first beginnings down to the present time can not be reduced to any such simple formula. There are three separate sets of facts to be considered, and any acceptable theory of animal development must harmonize and correlate all three.

Galago, similar to the supposed common ancestor of man and the monkeys

In the first place, within each of the so-called phyla or major groups of animals, as is well seen in the vertebrates, particularly in the mammals and the reptiles, there are many well marked, obvious, and undeniable evolutionary lines or "trees" which, beginning with a relatively simple form of creature, run by easy stages to a specialized and highly complex form.

In the second place, very few of these evolutionary lines are perfectly continuous. Practically all of them are more or less frequently interrupted by gaps of various widths, and these gaps are often very broad. Especially is it true that these evolutionary lines tend to be separated from each other throughout their entire course, running parallel clear through to their earliest beginnings and not converging to a common type of animal as we would expect. For instance the cat line and the dog line are always separate. No forms intermediate between cats and dogs are known, although both cats and dogs are collateral members of the great group of carnivorous mammals called the Carnivora and must have had a common ancestor.

SIMILARLY there are no intermediates between turtles and snakes, both types belonging to the reptiles, or between squid and oysters, though both types are mollusks.

In the third place, no animals are known even from the very earliest rocks which can not at once be assigned to the proper phylum or major group on the basis of the definition of that group as drawn up from a study of living animals alone. A backboned animal is always unmistakably a backboned animal, a starfish is always a starfish, a mollusk is always a mollusk, and an insect is always an insect, no matter whether we find it as a fossil in the rocks or catch it alive at the present day.

There can be only one interpretation of this entire lack of any intermediates between the major groups of animals, as for example between the backboned animals, the starfishes, the mollusks, and the insects. If we are willing to accept the facts at their face value, which would seem to be the only thing to do, we must believe that there never were such intermediates; in other words that these major groups from the very first all bore quite the same general relationship to each other that they do at the present time.

Is this creationism? Not at all. It simply means that from the single cell life, at its very first beginnings, developed simultaneously and at once in every possible direction. All of the phyla or major groups seem to be of simultaneous development. From each one of them a separate evolutionary tree arose, growing upward through the ages.

The numerous developmental lines are explained by the process of evolution as that term is commonly understood. This descriptive word should be restricted to these developmental lines.

THE gaps within these lines, and between related lines which run more or less parallel, are explained by the theory of mutation.

The complete absence of any intermediate forms between the major groups of animals, which is one of the most striking and most significant phenomena brought out by the study of zoology, has hitherto been overlooked, or at least ignored. This condition may readily be explained, from an application of the facts gained from a study of embryology, by a theory which may be called the "theory of eogenesis."

Restriction or expansion of the meaning of a well-known word results always in confusion. The term evolution has been used to cover the entire developmental history of animals. But the theory of evolution is based upon, or at least was drawn up from, only a portion of the facts to be explained. It was formulated from data taken from only a partial survey of the field. A better understanding of the whole subject of the development of animals will result if we call it "zoogenesis" and consider zoogenesis to embrace three interrelated phases, (1) evolution, (2) mutation, and (3) eogenesis.

WITH regard to evolution, the first of these three phases: To illustrate evolution as here restricted let us briefly review the history of the mammals and the reptiles, bearing in mind that similar histories are found in many other less familiar forms of life.

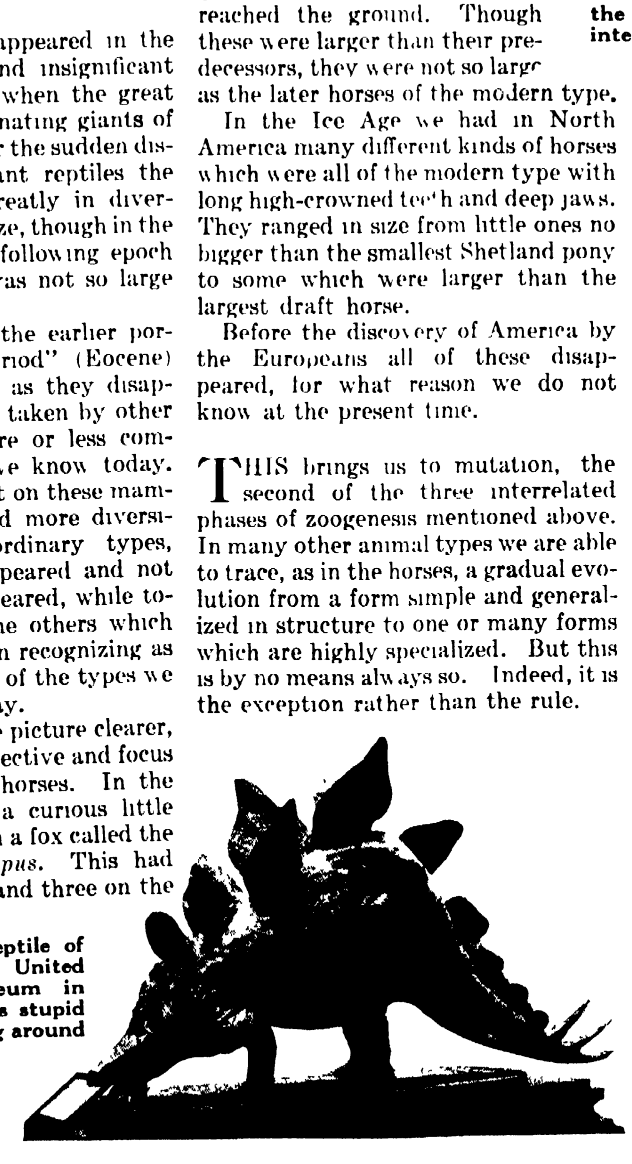
The reptiles first appeared in that very ancient time which is known to geologists as the Carboniferous, and gradually increased in diversity and in maximum size. The largest land animals of which we have any knowledge are the largest of the dinosaurs, which flourished in those periods known as the Jurassic and Cretaceous.

At the end of the Cretaceous period most of the larger and more spectacular of the reptiles suddenly disappeared, but many reptilian types, as turtles, lizards, snakes and crocodilians, continued right through to the present day.

The mammals first appeared in the form of very small and insignificant creatures at the time when the great reptiles were the dominating giants of the land and sea. After the sudden disappearance of the giant reptiles the mammals increased greatly in diversity and somewhat in size, though in the earlier portion of the following epoch the largest mammal was not so large even as a sheep.

These mammals of the earlier portion of the "dawn period" (Eocene) soon disappeared; but as they disappeared their place was taken by other types which were more or less comparable to the sorts we know today. Gradually as time went on these mammals became more and more diversified. Various extraordinary types, some of huge size, appeared and not long afterwards disappeared, while together with these came others which we have no difficulty in recognizing as the direct predecessors of the types we know at the present day.

In order to make the picture clearer, let us narrow our perspective and focus our attention on the horses. In the "dawn age" we find a curious little creature no bigger than a fox called the "dawn horse"—*Eohippus*. This had four toes on the front and three on the hind feet, and a relatively short head with the eyes about half way between the ears and the tip of the nose, instead of nearer the ears as in the later horses.



Stegosaurus, extinct reptile of the Cretaceous period, United States National Museum in Washington. When this stupid big brute was lumbering around in Wyoming in the Cretaceous period the ancestor of all the modern mammals was no larger than a rat

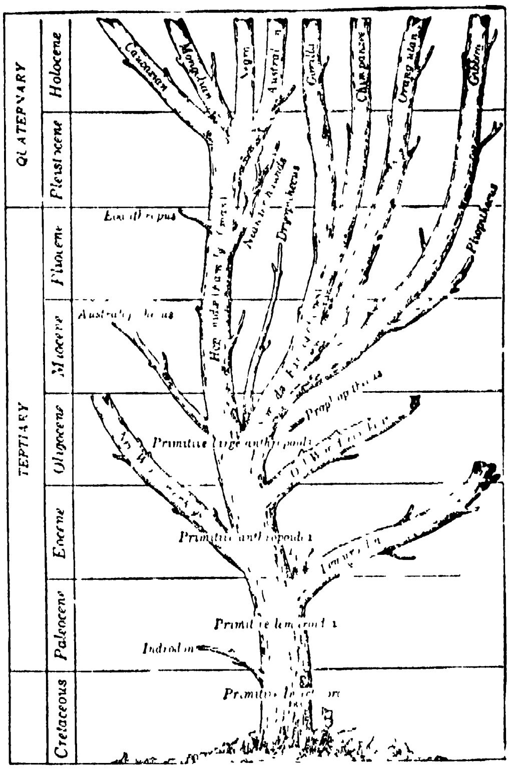
Following the "dawn horse" we find a number of different kinds of horses, mostly about the size of a shepherd dog or a little larger, all of which had three toes. Like the "dawn horse" and its relatives they had low-crowned teeth which were affixed to the jaw by means of roots.

Still later there were horses which as colts had low-crowned teeth but when fully grown had teeth with fairly high crowns. With these lived others in which the teeth had high crowns at all ages. These horses had shorter muzzles and rather less deep jaws than the modern horse and, while they had a single rounded hoof, there was a toe on either side of it. These lateral toes varied from small ones which did not reach the ground to larger ones which reached the ground. Though these were larger than their predecessors, they were not so large as the later horses of the modern type.

In the Ice Age we had in North America many different kinds of horses which were all of the modern type with long high-crowned teeth and deep jaws. They ranged in size from little ones no bigger than the smallest Shetland pony to some which were larger than the largest draft horse.

Before the discovery of America by the Europeans all of these disappeared, for what reason we do not know at the present time.

THIS brings us to mutation, the second of the three interrelated phases of zoogenesis mentioned above. In many other animal types we are able to trace, as in the horses, a gradual evolution from a form simple and generalized in structure to one or many forms which are highly specialized. But this is by no means always so. Indeed, it is the exception rather than the rule.



From Shimer's Evolution and Man Courtesy Ginn & Co

Evolution of the primates. The author accepts man's ultimate relationship with the apes but points out that there is no intermediate type, either living or extinct

Most lines are broken by curious gaps which may be small and insignificant, or broad and striking. It is commonly assumed that these various gaps are due to our lack of knowledge of the animals concerned, and especially of their fossil record. No doubt in very many cases this is true, but in most cases these gaps probably are real and were never bridged by "missing links."

In the light of our present knowledge we can not doubt that all living things are the children of other living things, and that life has been continuous from parent to child from its earliest beginnings. How is it possible to harmonize this fact with the occurrence of broad and unbridged gaps in the evolutionary lines?

THE answer is, that continuity of life does not necessarily imply continuity of the bodily form in which that life is manifested. In other words, children may be very different from their parents. As an illustration of continuity of life coupled with abrupt and striking discontinuity in form, and also in mental traits, let us consider the dogs.

According to the best authorities all of the nearly 200 different breeds of domesticated dogs are descended from a single type of ancestor, which is a wolf closely resembling our native wolf. The domestic dogs may be grouped, following Gibson, into wolf-dogs, greyhounds, spaniels, hounds, mastiffs and terriers.

Some of the wolf-dogs, like the dogs

of the Esquimaux and the Kamchadales, show a more or less close resemblance to wolves, while others, like the collies, Newfoundlands and St. Bernards, are much less wolf-like. But the wolf-dogs may be arranged in a fairly continuous series from the most to the least wolf-like. This series of dog forms is parallel to many of the evolutionary lines which are seen in the geological history of the mammals, as for example, in the horses. It is a series of types passing by almost imperceptible gradations from one extreme to another which is very different.

Of the other types of dogs we may select the greyhounds, hounds, bull-dogs and pugs, the last two from the mastiff stock, as representative types known to every one.

THE greyhounds or, as they are sometimes called, the "gaze-hounds" have deficient powers of scent, but unusually keen eyes. They hunt entirely by sight. There are many different forms of greyhounds. The hounds, having poor sight, hunt by scent, and are also divided into many different forms. Bull-dogs are deficient both in sight and scent, and are stupid and ferocious, displaying but little affection. Pugs, which are much like bull-dogs and are equally stupid, differ markedly from them in being timid and affectionate.

There are no intergrading types between the greyhounds, the hounds, the bull-dogs and the pugs, and there are no intergrades between any of these and wolves. If we did not know their ancestry we would never suspect that these types of dogs had anything to do with each other, or with wolves. They illustrate unbroken continuity of descent coupled with wide and abrupt changes in form and in mental attributes.

An understanding and appreciation of the conditions found among the dogs enables us to approach the problem of the relation of man to the animal world.

Structurally and anatomically man is very close to the man-like or anthropoid apes. This is a readily demonstrable fact which is quite beyond dispute. But it is also beyond dispute that there is a sharp, clean cut, and very marked difference between man and the apes. Every bone in the body of a man is at once distinguishable from the corresponding bone in the body of any of the apes.

Furthermore, man differs very widely from the apes in the possession of articulate speech which enables him to accumulate knowledge in successive generations. He also differs in his use of fire and in his use of tools which, as is shown by the fossil record, have been human attributes from the very first. Besides this, so far as history and the study of modern races enables us to judge, he differs in his use of clothing and of ornaments.

Some remarkably well preserved fossils from the Cambrian period of British Columbia, nearly a billion years ago, almost our oldest fossils, yet doubtless not half as old as life. Even in the Cambrian, the author states, the major phyla were as distinct as today, with no intermediate forms

The most important difference, however, is correlated with the fact that in man the ministrations of both parents are necessary in raising a family. A woman can not raise a family unaided. Interdependent with this we find in man a socially effective sentiment of love which creates and makes a unit of the family. The existence in all human races of taboos and laws directed toward the maintenance of the family would seem conclusively to show that family life was from the first a fundamental human institution. For laws and taboos are not, so far as we know, invented to mold society into a new and preconceived form, but on the contrary to correct the evils recognized as possessing disruptive or destructive tendencies which from time to time appear.

All monkeys, so far as we know, live together in promiscuous hordes or troupes in which each female raises her own young unaided. Family attachments are not necessary and do not occur.

While man obviously belongs to the same division of the mammals as the apes, yet the differences between man and the apes seem to be too great ever to have been bridged by intermediate types, and of all the fossils that have been found not a single one represents indubitably a "missing link."

Man appeared suddenly as a collateral line from the same general complex as the apes, but he was never one of them. Between man and the apes there is a gap, structural and psychological, of the same general nature as that between the greyhounds, hounds, bull-dogs and pugs. But while we know that the domesticated dogs are all descended from a wolf, a creature differing from all of them, and very widely from most types, we have no definite clue to the immediate ancestor of man.

The general features of human structure and anatomy were inherited, in accordance with the unbroken continuity of descent from parent to child, from some unknown ancestor common to all the primates but so far as we have been able to discover, not through an ape. The details of his structure and his mentality are his alone.

Continuity of descent coupled with abrupt discontinuities or changes in form is a common, striking, and well known phenomenon in most types of animal life. We must accord it a proper place in any theory dealing with zoogenesis.

FINALLY, with regard to eogenesis, the third phase: As we look over a series of fossils from the very earliest rocks, those of the Cambrian, we notice sponges, mollusks, crustaceans, echinoderms, and various other types of invertebrate life. Among the divisions of these groups we recognize pteropods and gastropods, crinoids, sea-cucumbers or holothurians, gephyreans, polynoids, and many other sorts.

How is it that we are able to recognize these so promptly? The reason is that these earliest animals all fall within the several phyla or major groups as these phyla are defined on the basis of the living types alone. We do not have to expand our definitions of the phyla to include all the fossil forms of whatever age.

The very earliest vertebrates, crustaceans, insects, or mollusks were just as unmistakably vertebrates, crustaceans, insects, or mollusks as are the representatives of those groups which we find living at the present day.

What is the significance of this? It

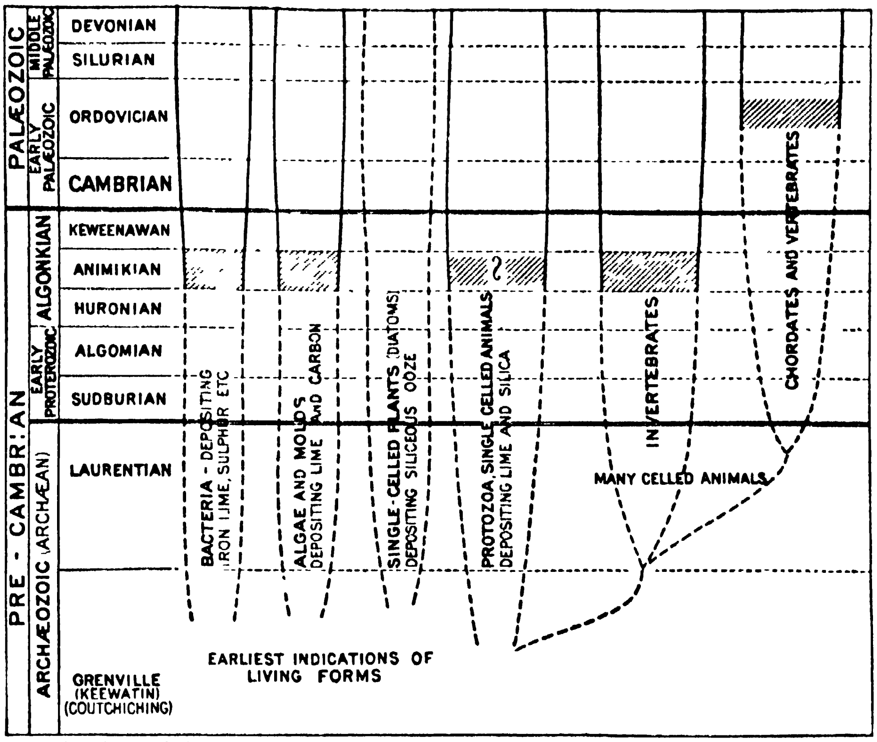
can have only one meaning, and that is, that so far back as Cambrian times, at least, the major groups of animals bore the same relationships to each other that they do today.

This is an established fact concerning which there can be no doubt whatever. In spite of the numerous and profound changes that have taken place in the various sorts of animals included *within* each phylum, the interrelationships *between* the phyla themselves have undergone no change at all. No intergrading forms occur between any two of the major groups, and so far as we know no intergrading forms ever have occurred.

WHILE the fossils in the Cambrian rocks are the very earliest fossils that are adequately known, yet it is undoubtedly true that the Cambrian is much nearer to the present epoch than it was to the far distant time when life on earth began, so that conditions in the Cambrian are not necessarily those which obtained at the time of the origin of life.

The answer to this objection is that since we know that the interrelationships between the phyla or major groups run back without the slightest change to the Cambrian, it is more logical to assume a continuation of these interrelationships into the indefinite past than it is to assume, somewhere in the unknown pre-Cambrian ages, a change in the interrelationships, for which last assumption there is not the slightest evidence.

Since there is nothing to be learned bearing on the interrelationships of the phyla from a study of the fossils, in order to solve the problem we must rely on the data supplied by the study of the special science of embryology.


PALÆOZOIC
MIDDLE PALÆOZOIC
EARLY PALÆOZOIC
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
PRE - CAMBRIAN
ALGONKIAN
EARLY PROTEROZOIC
ARCHÆOZOIC (ARCHÆAN)
KEWEENAWAN
ANIMIKIAN
HURONIAN
ALGOMIAN
SUDBURIAN
LAURENTIAN
GRENVILLE
(KEEWATIN)
(COUTCHICHING)
BACTERIA - DEPOSITING IRON LIME, SULPHUR ETC
ALGAE AND MOLDS DEPOSITING LIME AND CARBON
SINGLE-CELLED PLANTS (DIATOMS) DEPOSITING SILICEOUS OOZE
PROTOZOA, SINGLE CELLED ANIMALS DEPOSITING LIME AND SILICA
INVERTEBRATES
CHORDATES AND VERTEBRATES
MANY CELLED ANIMALS
EARLIEST INDICATIONS OF LIVING FORMS

After Osborn "Origin and Evolution of Life" Courtesy Charles Scribner's Sons

Earliest phyla of plant and animal life. Note the five shaded areas; these represent the geologic date of the earliest known fossil forms. The duration represented by the part of the chart below (earlier than) this date is about one billion years and the dotted line relationships are filled in wholly by inference

The details of the process by which all of the phyla or major groups presumably arose simultaneously, or practically so, from a primitive single cell are very complicated and too technical for repetition here. They are given at length in a paper entitled "The Origin of the Vertebrates" (*Journal of the Washington Academy of Science*, Volume 13, No. 7, April 4, 1923, pages 129-138) to which the interested reader is referred for these details.

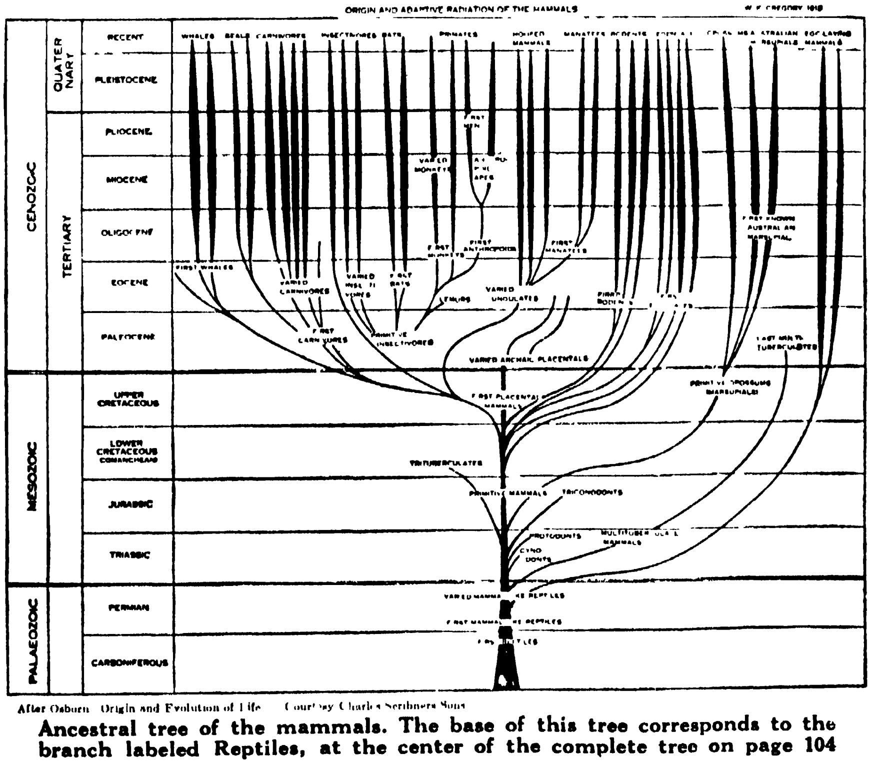
Thus, by a process which has been designated as eogenesis, all of the phyla or major groups of animals appeared simultaneously or nearly so. Although this sudden and simultaneous origin gives them the appearance of having arisen through special creation, *the origin of each may be traced back to the primitive single cell.* However, there is no evidence that single celled animals—the protozoans are more primitive than other types, or preceded them.

By this process of eogenesis the phyla or major groups came into being, and each of these stands at the base of a separate and distinct evolutionary tree which rises upward through the ages.

THE branches, branchlets and twigs of these evolutionary trees are indicated by interrupted lines, the interruptions or gaps representing mutations whereby discontinuities in form and structure occurred between parent and child.

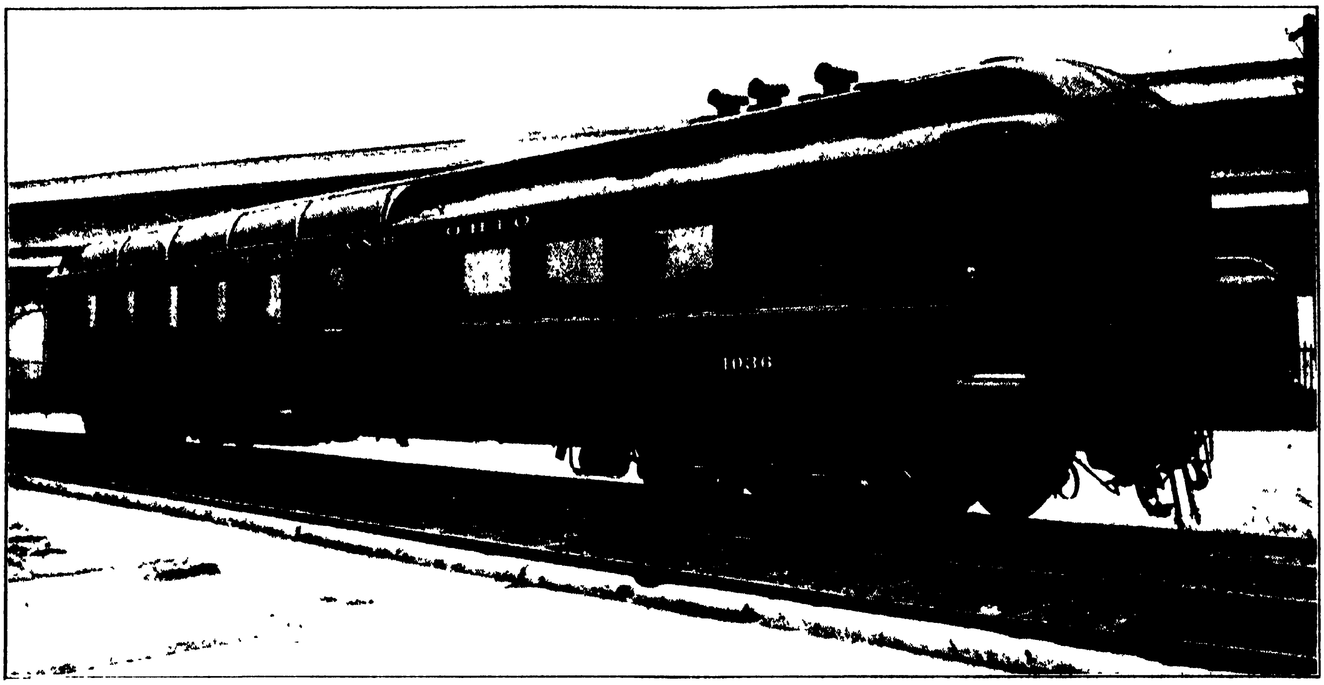
This is the picture of the development of animal life—of zoogenesis—which is to be drawn from the facts as we know them, and it is the only possible picture which is in accordance with those facts.

This new concept of evolution differs from the old chiefly in the assumption that the basic type in each of the major groups (phyla) arose through following a special developmental path from the primitive cell, the divergence for the most part beginning in the so-called gastrula, a developmental stage common to all animals except the sponges and the protozoans.



After Osburn "Origin and Evolution of Life" Courtesy Charles Scribners Sons

Ancestral tree of the mammals. The base of this tree corresponds to the branch labeled Reptiles, at the center of the complete tree on page 104



Exterior of dining car. Much of the air-cooling and air-conditioning apparatus is concealed underneath the car. The curved hood along the top of the car at the farther end contains the air passages connecting with the louvres

Dining in a Refrigerator!

SUMMER rail travel is rendered uncomfortable by heat, dust, cinders, smoke, and noise. Engineers have been working for many years to mitigate these evils but the problem has been a most difficult one, for the air must be freed from all foreign matter before it can be dehumidified and cooled. A refrigerated car would be a great boon in traversing the great deserts of the southwest. Natural ice has been tried, but the expense was too great.

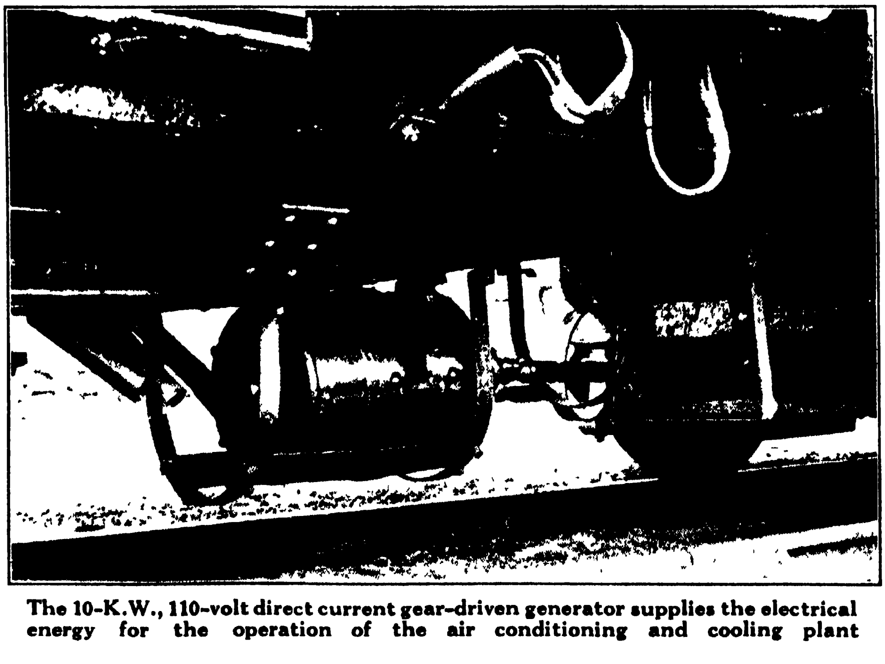
Now, however, the riddle apparently has been solved. The design and installation of the special equipment required was co-operatively worked up by the Baltimore and Ohio and the Carrier Engineering Corporation and the complete installation was made at the Mount Clare shops at Baltimore.

A run was made, with the full winter heating capacity of the car turned on. This was intensified by the heat of the kitchen and the warm weather outside. When the temperature reached 93 degrees, Fahrenheit, the new system was put in operation and in 20 minutes the temperature had dropped to 70 degrees, or more than a degree a minute. It was also shown that the temperature could be lowered considerably further but this would not often be necessary or desirable.

THE automatic control of the air-conditioning and cooling apparatus can be set by the steward or whoever is in charge of the car. The cooling equipment as well as the running gear of the car is so insulated with rubber cushions that vibration and noise are very largely eliminated. The car is also equipped with roller bearings.

The cycle of operations will be understood by reference to the schematic diagram. The car is equipped with double sash windows which are kept closed at all times and the doors are opened and closed only to allow for the entrance and exit of the passengers and the train crew. The outside air is admitted through air filters located at the roof line. All the dust and cinders are removed from the air by mechanical filtration. The air is then cooled to the proper temperatures by passing over cooling coils. It is then carried throughout the car by overhead insulated ducts. There are no drafts created and the cool dehumidified air is distributed through louvres.

The equipment is electrically operated and as the requirements are in excess of the ordinary axle generator for lighting purposes, a special 10-kilowatt generator has been provided to supply direct current of 110 volts. The water used in the condenser is delivered by a motor-driven pump to a "cooling tower" or "spray unit" at the end opposite the kitchen where fresh air drawn from the outside is passed



The 10-K.W., 110-volt direct current gear-driven generator supplies the electrical energy for the operation of the air conditioning and cooling plant through the water spray, and thus the temperature of the condensing cooling water is brought back to approximately that of the outside air after which the water is available for re-circulation. The water which is lost by evaporation is taken from an overhead supply tank.

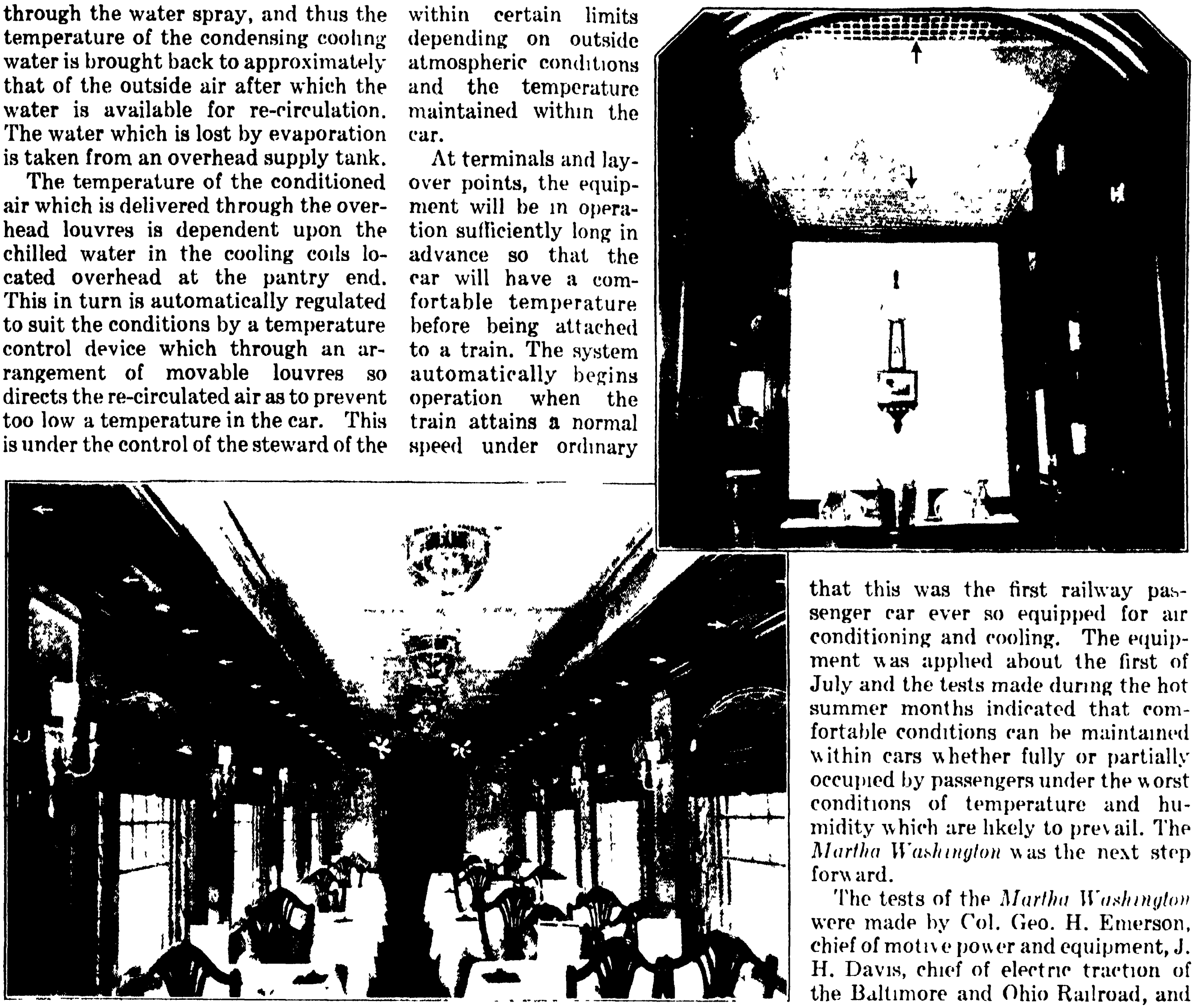
The temperature of the conditioned air which is delivered through the overhead louvres is dependent upon the chilled water in the cooling coils located overhead at the pantry end. This in turn is automatically regulated to suit the conditions by a temperature control device which through an arrangement of movable louvres so directs the re-circulated air as to prevent too low a temperature in the car. This is under the control of the steward of the car so that a comfortable temperature will be maintained at all times. If the temperature of the cooling water becomes too low, freezing of water in the evaporator may occur. To prevent this the back-pressure valve in the ammonia system will automatically cut off the supply of ammonia, thus preventing a further lowering of the temperature. The relative humidity can be controlled within certain limits depending on outside atmospheric conditions and the temperature maintained within the car.

At terminals and layover points, the equipment will be in operation sufficiently long in advance so that the car will have a comfortable temperature before being attached to a train. The system automatically begins operation when the train attains a normal speed under ordinary conditions. The time when the equipment is not functioning because of low speed, or while standing at stations, is so small that the loss would be negligible, and comfortable conditions can be maintained at all times.

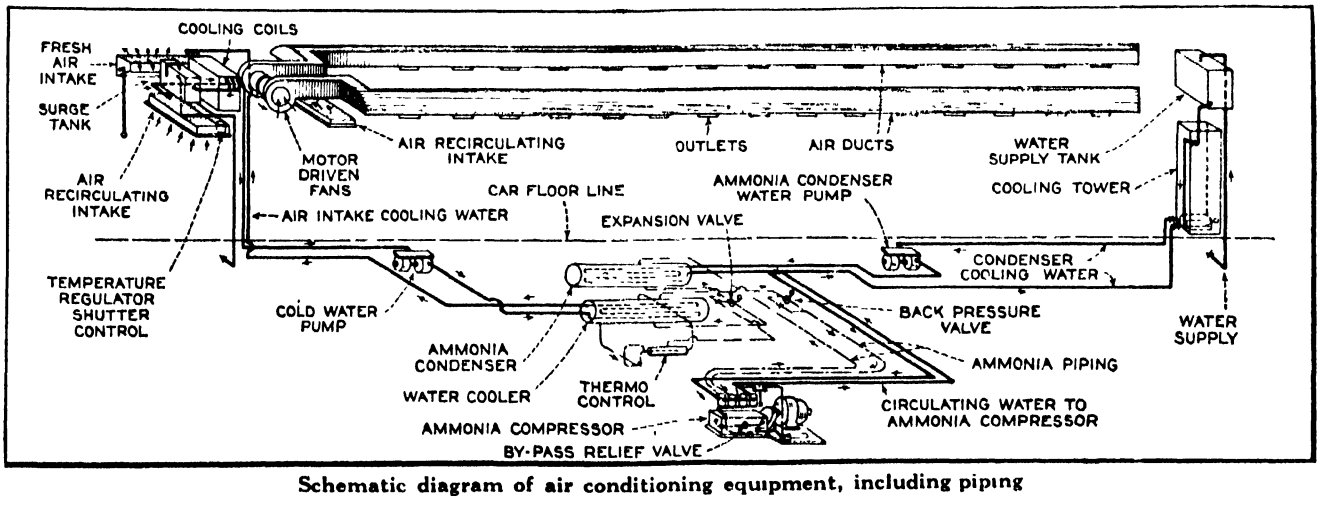
Early in July, 1929, tests were carried out by the Baltimore and Ohio Railroad and the Carrier Engineering Corporation with a coach. It is believed that this was the first railway passenger car ever so equipped for air conditioning and cooling. The equipment was applied about the first of July and the tests made during the hot summer months indicated that comfortable conditions can be maintained within cars whether fully or partially occupied by passengers under the worst conditions of temperature and humidity which are likely to prevail. The *Martha Washington* was the next step forward.

The tests of the *Martha Washington* were made by Col. Geo. H. Emerson, chief of motive power and equipment, J. H. Davis, chief of electric traction of the Baltimore and Ohio Railroad, and officials of the engineering company. This was the first car in service on any railroad to be so equipped.

The next problem which should be attacked is the air conditioned and refrigerated sleeping car. This is a much greater engineering problem than the dining car for the reason that the cubical space to be treated is much larger, as quite a bit of the diner is taken up with kitchen, pantry, and passageways. There is an abundant field for the ingenuity of the engineer along this line of endeavor.



Interior of the *Martha Washington*. Most of the apparatus is underneath the car and that part of it which is inside is concealed or worked into the decorations. Arrows indicate the louvres for air delivery. *At top:* Re-circulation vents at kitchen end. The air passes over cooling coils and is re-delivered



Schematic diagram of air conditioning equipment, including piping

First glance at this Moorish type adobe house in Lima, Peru, would give the impression that it is of plaster

A home in Miraflores in the American colonial style. It is of adobe and might melt away in a heavy rain

Built of Mud

By A. HYATT VERRILL

WHEN we think of a mud house we usually visualize a mere hut or shanty, but in many portions of the world, mud, or adobe, is the principal building material. In the Orient, in sections of Europe, and particularly in Spanish America, buildings of adobe construction are the rule rather than the exception. Quite pretentious houses and other edifices are built of mud and, when stuccoed, whitewashed, or gaily painted, give no hint of the material of which they are composed.

In no other part of the world, however, has adobe construction reached such a state of development and attained to such heights as in Peru. Long ages before the Spaniards first set foot on Peruvian soil, the Incans and the pre-Incan tribes had learned the use of mud as a building material. Enormous walls, great mounds, countless dwellings, vast temples, and massive forts were built of the sun-dried mud bricks and blocks, and many of these still remain, little altered by time and the elements.

THE Dons followed their example and used the cheap and easily obtainable adobe in erecting their buildings. Their palaces, forts, homes, and churches were made entirely of adobe mud, and through the centuries these have endured and remain today as imposing and as beautiful as in the days of Pizarro.

It was left to the modern inhabitants of Peru, however, to carry mud adobe construction to the *n*th degree and literally to glorify mud. In and about the capital, Lima, is this particularly true. Of course, today, many of the business buildings, as well as residences, are of concrete or brick, but adobe still holds its own, and by far the greater number of Lima's homes, as well as a large proportion of its larger edifices, are entirely of mud.

In the days of the Conquistadors, the adobe bricks were merely piled one upon another to form the building walls, but today the usual method is to erect a light wooden framework and build the adobe upon this. In some cases metal frameworks have been used in connection with adobe. This method was employed in erecting the beautiful Rimac Building, perhaps the most elaborate mud building in the world. On the other hand, the world's largest mud building, the old Lima Cathedral, is built of adobe blocks without reinforcement of any kind.

A mud building that has stood for over three centuries. The Torre Tagle Palace

Apparently there are no limits to what may be accomplished with mud in Peru. There are charming, one-storied bungalows with wide verandas, Moorish palaces, imposing colonial mansions, Elizabethan cottages, Spanish mission homes, and even turreted castles, all built of the same sun-dried mud dug from the land on which the edifice is built. So great is the demand for adobe that everywhere, 'round and about Lima, one sees endless piles and high walls of the mud bricks. At first one thinks these merely boundary walls between properties, but it will be noticed that in nearly every case these walls are marked: "*Este pared no es medianera*"—"This wall is not a boundary."

ALSO, wherever there is available mud, one will see the natives industriously engaged in making adobe bricks.

The mud, dug from any convenient spot, is mixed with sand and usually with some chopped straw or dried manure. The resultant pasty mass is then pressed into wooden forms or frames. The shaped blocks are then removed and placed in the sun to dry and in a day or two are ready to use.

Brick making is a most

economical and inexpensive business for a man of limited means, or of no means at all. Provided he can secure permission to make use of the land, or a portion of its surface, for brick making—usually an easy matter, for the rental is taken out in completed bricks—the penniless brick-maker needs little more than his bare hands. With his wife and children, and all his worldly goods—which usually amount to nothing more than a few battered tins, and some hand-made stools—he camps upon the selected site. An ancient kerosene tin of water and a dilapidated shovel are produced. The dry earth is trod, dug, stirred, and worked into a thick paste; then some dry manure, gathered anywhere along the road, is added, and with all members of the little family helping, the bricks begin to take form. As soon as they dry they are piled in tiers.

The fine old Cathedral in Lima, the largest adobe building in the world, built in the Sixteenth Century

In a few days the brick-maker and his family are surrounded by brick walls and are living quite comfortably and snugly in a little cavity left purposely for their accommodation. Here they remain as long as bricks can be made and sold on the land. And when an adobe building is in process of erection, the laborers invariably dwell within recesses in the piles of accumulated bricks thus saving house rent—and tramp back and forth to their work.

WHEREVER a Cholo can find a mud-brick wall and employment, is "Home Sweet Home" to him, and often one may find a dozen or more families all dwelling in perfect contentment in their burrows in the piles of bricks where building is in progress.

In a damp or rainy climate, these dried mud-bricks would, of course, be worse than useless; and, should Lima be subjected to a few days of really heavy rains, most of the city and its suburbs would be reduced to the original, elemental mud. Several times within the past few years, various portions of Peru have been visited by unprecedented rains during the winter months, and great has been the havoc wrought. Around and about Trujillo, houses and churches melted like snow exposed to sunshine, and even the prehistoric ruins of the Chimu city of Chan Chan, which has stood unaltered for countless centuries, slumped and dissolved.

To protect buildings from the drip from the eaves, practically all modern adobe buildings have several feet of the wall covered with concrete, while others have the lower portions of the walls built of stone, or stone and concrete. Even the old cathedral, which is not only the largest but one of the finest adobe buildings in the world, has been safeguarded with a concrete coating about the base of its walls.

Originally, too, the adobe buildings were all very much alike. They were massive, thick-walled, square, and usually of moderate height, were typically Spanish with iron-grilled windows, out-jutting carved cedar miradors, immense iron-studded and elaborately carved doors, and open patios. But with the modern improvements in adobe constructive methods, architecture appears to have run wild, and there is scarcely a type or style of buildings known to any part of the world the counterpart of which cannot be seen in or about the Peruvian capital.

Apparently the average Peruvian never has a definite plan in view when he starts building a house. He may start with a Spanish colonial form and by the time the first story is complete, he decides that the English style is better. He then adds a second story with exposed timbers, leaded glass windows, and stucco walls. Then to the steeply-pitched roof, he adds Spanish tiles, and among the chimney-pots erects a cupola where he can loll away many a hot evening.

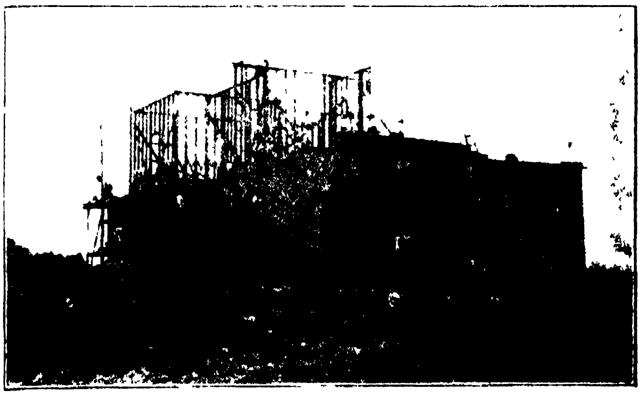
HIS front door may be a graceful Moorish arch, but to put a finishing touch to the whole he adds the lofty pillars and severe portico of some Virginia mansion, and builds a *porte cochere* in Japanese style.

But with all his architectural failings, he loves color, and so paints his home in brilliant ultramarine, rose-pink, canary-yellow, or a combination of all. And, strange as it may seem, these architectural monstrosities do not strike a discordant note in the scheme of things. Surrounded by glorious flower gardens and magnificent pines and luxuriant palms, their bright hues are delightful, and one forgets their faults in admiration of the masses of roses and geraniums which clamber over walls and droop from the eaves.

And there are countless dwellings which are as charming and as perfect in their architectural features as one could wish.

Truly, the Peruvians have glorified mud, and by the same token, they have attained the utmost in building economy, for what could be more economical than to build one's home from the crude material dug from the land when excavating foundations or grading one's garden?

"Not a boundary wall." Piles of bricks ready for use and others drying in the sun at a native brick "factory"



Building an adobe house with a wooden frame. Construction is quite simple but the structure is substantial

Basic Patents in Evolution—I

By WILLIAM K. GREGORY

Professor of Vertebrate Paleontology, Columbia University Curator, Departments of Anatomy and Ichthyology, American Museum of Natural History Member, National Academy of Sciences

THE latest airship, crowded with powerful motors and directed by means of numerous instruments of precision, at first sight seems bewildering in its complexity; yet with a little assistance from the experts, one readily comprehends at least the general purpose and arrangement of its principal parts. The human body is vastly more complex than any airship, both in its locomotor machinery and in its instruments of precision; but at least the leading features of its construction and operation may be outlined with but little resort to the technical jargon of the anatomist and the physiologist.

In the case of the airship every mechanism and device doubtless has been developed from some earlier and simpler predecessor, which in turn rests eventually on one or more "basic patents," or primary inventions. An expert willing to search the records of the Patent Office could easily trace the steps in this evolution. Unfortunately, during the long ages when the "basic patents" of the engines of the human body were being tried out in Nature's testing grounds, no patent office records were being made. Nevertheless, the labors of several generations of comparative anatomists, paleontologists, and embryologists have enabled us to piece together the probable history of the human body by comparative methods, which do not differ essentially in principle from those that have been employed successfully by the archeologists or the Egyptologists in reconstructing the main sequence of historical events during long periods of time.

IT may be affirmed on good evidence that the skeleton of any given type of animal contains both a clear record of its present habits and a more or less obscured record of the habits of the earlier stages that led up to it. For example, the skeleton of a penguin (Figure 1, A) reveals many features, such as the paddle-like form of the wing bones, that are obviously connected with this bird's peculiar habit of "flying" under water. Yet many other features, such as the keeled breastbone, testify that the highly specialized and now flightless penguin traces its remote origin to birds that used their wings for flight in the air in the normal way. Again, the skeleton of a vulture (Figure 1, B) is beautifully adapted in very many ways for the habits of this bird of strong flight and predatory instincts. But it also abounds in other characters that have been inherited from the earliest reptiles that first began to skim down from the trees and flap their large skinny arms in the first feeble attempts at flight.

Examples could be multiplied of similar instances in which the "basic patents" acquired by earlier generations are transmitted, even though much disguised in external appearance, to remote descendants. In more technical language, the "habitus" (or totality of characters that adapt an animal to any given mode of life) may, under changed environments and habits, persist in part as the "heritage" of later times.

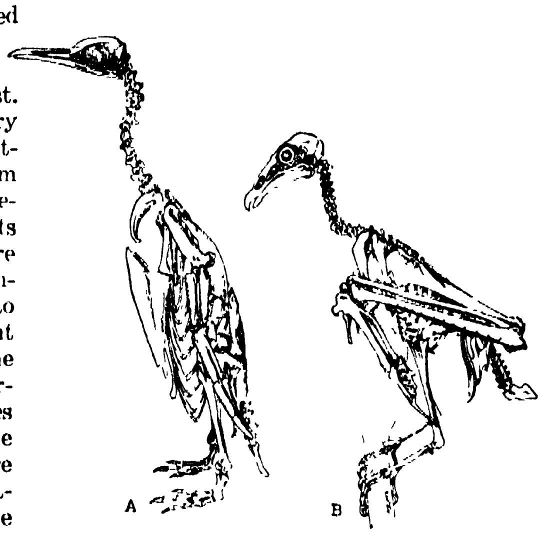


Figure 1: **Skeletons of penguin (left) and of vulture (right), showing swimming "habitus" of the penguin and strong-flying "habitus" of the vulture. Both retain many features in common, which constitute the primary "heritage" of birds**

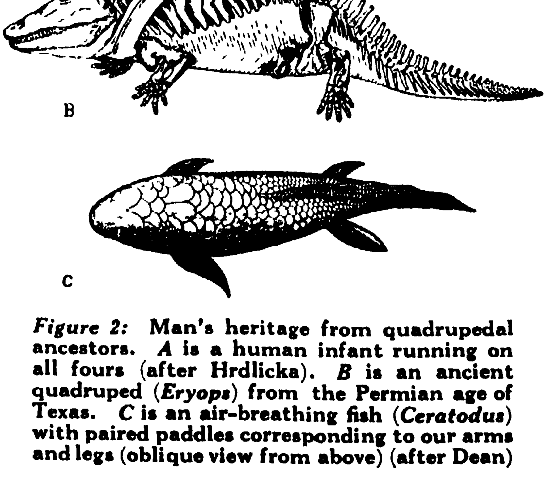


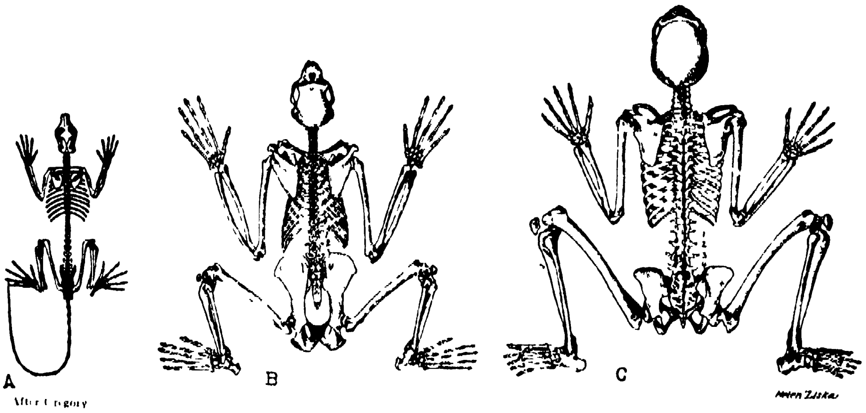
Figure 2: **Man's heritage from quadrupedal ancestors. *A* is a human infant running on all fours (after Hrdlicka). *B* is an ancient quadruped (*Eryops*) from the Permian age of Texas. *C* is an air-breathing fish (*Ceratodus*) with paired paddles corresponding to our arms and legs (oblique view from above) (after Dean)**

With this well established principle in mind, let us make a preliminary comparison (Figure 3) of the human skeleton with those of other animals for the purpose of determining its present "habitus" and of uncovering its prehuman "heritage." As to the "habitus" characters, even a cursory inspection of the human skeleton reveals the fact that it is beautifully adapted to support the body in the erect position, with the center of gravity a little above the points of support at the hip joints, immediately above the limbs. The human pelvis (the hip bones) is likewise fitted in many other ways to act as a bony anchor for the muscles that tie in the abdominal viscera, and as a base for the powerful thigh and back muscles that hold the body erect.

THOSE who believe in the sudden creation of Adam from the dust of the ground usually go no further than to say that such adaptations are part of the Divine Plan, and that the origin of this plan is one of the inscrutable mysteries of creation. But in practice such a philosophy usually blocks further inquiry. The naturalist, on the other hand, points to the basic similarity of the entire skeleton of upright-walking man to the skeletons of quadrupeds that run with the backbone parallel to the ground. Moreover, he can point to a long series of "heritage" characters in the human skeleton which appear to be inexplicable on any other scientific hypothesis than that man is a quadruped that has learned to walk on his hind legs (Figure 2). In the anatomical sense man is still a quadruped, since his fore limbs clearly correspond, bone for bone and muscle for muscle, with those of his nearest quadrupedal and semiquadrupedal relatives, the apes and monkeys.

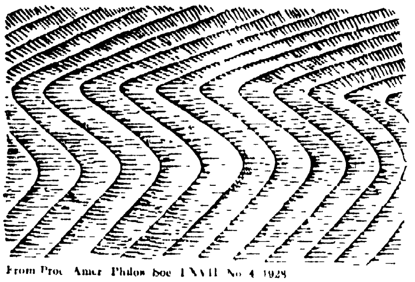
To review even the main steps in the long ascent from fish to man would be too extensive an undertaking for our available space, as the technical papers bearing on the subject run into many hundreds; but nevertheless let us attempt to notice a few of the many "basic patents" along the way.

There is not much use in inquiring here where the fish itself came from, for professional opinion hesitates between the "jellyfish" and the earliest sea-scorpions or eurypterids. But wherever he came from, the shark is already far nearer to man in his anatomical ground-plan than he is to any known animal that completely lacks a backbone. For this reason the humble dogfish, or small shark, is recognized everywhere as a veritable epitome of human anatomy, and all properly qualified pre-medical students find that dissection of the dogfish gives them a welcome clue to the anatomical intricacies of their future patients.



After Gregory

Figure 3: **Man's heritage from his anthropoid ancestors. *A* is a skeleton of an ancient fossil primate from the Eocene age. *B* is a skeleton of a chimpanzee. *C* is a skeleton of man, placed in the same position as *A* and *B***

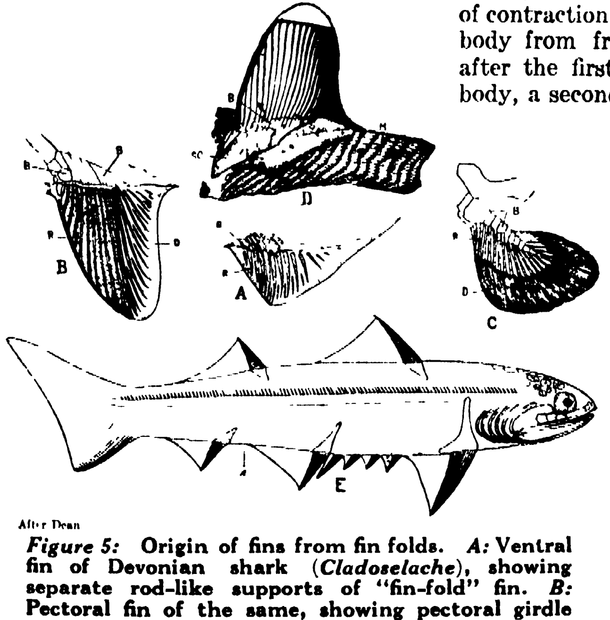


From Proc. Amer. Philos. Soc. LXVII No. 4 1928

Figure 4: **Diagram of arrangement of muscle fibers as shown on the inside of a piece of dried shark's skin. In this "basic patent" of the locomotor machinery of all vertebrates from shark to man, the horizontal red muscle fibers are attached to zigzag connective tissue partitions, or "myosepta," the whole W-shaped muscle segment forming a "myomere"**

LET us consider first the shark's locomotor machinery and then inquire what parts of it are still recognizable in human anatomy. The "basic patent" of the entire locomotor machinery of the shark is the striped, or voluntary, muscle fiber (Figure 4). The mechanism of this simple-looking little thread is slowly yielding its secrets to the siege of the physiologists. The muscle fiber has been broadly characterized as a "tiny gas engine," but it differs from an ordinary gas engine in using its oxygen in the recovery stage rather than in the work-producing stage. Vast numbers of the red muscle fibers of the shark are grouped in broad zigzag zones called myomeres, or muscle segments, arranged in tightly packed rows along the sides of the body. The ends of the muscle fibers are fastened to the connective tissue partitions that both separate and connect adjacent myomeres. By means of the delicate nerve fibrils that run to each red muscle cell the contraction of the myomeres is timed so that a wave of contraction runs along the side of the body from front to rear. But soon after the first wave starts along the body, a second begins on the opposite side, then a third on the same side, and so forth. By this very simple device the body of a long-bodied fish is itself thrown into a series of backwardly-passing waves, which by their reaction against the water, drive the fish forward.

This simple arrangement was also the starting-point for the most complex locomotor machinery of the higher vertebrates. The zigzags of the myomeres soon lose their primitive simplicity. In some sharks, as we pass along the side of the body toward the tail, the tips of the zigzags become greatly prolonged and the connective tissue sheaths of corresponding tips of successive zigzags tend to adhere and unite so as to produce tendons that transmit to the tail the pull of the less modified muscle segments farther forward. And in higher fishes those parts of the muscle zigzags that control the movements of the pectoral fins often fuse into compound muscles that clearly suggest the muscles that move the limbs in the higher vertebrates.



After Dean

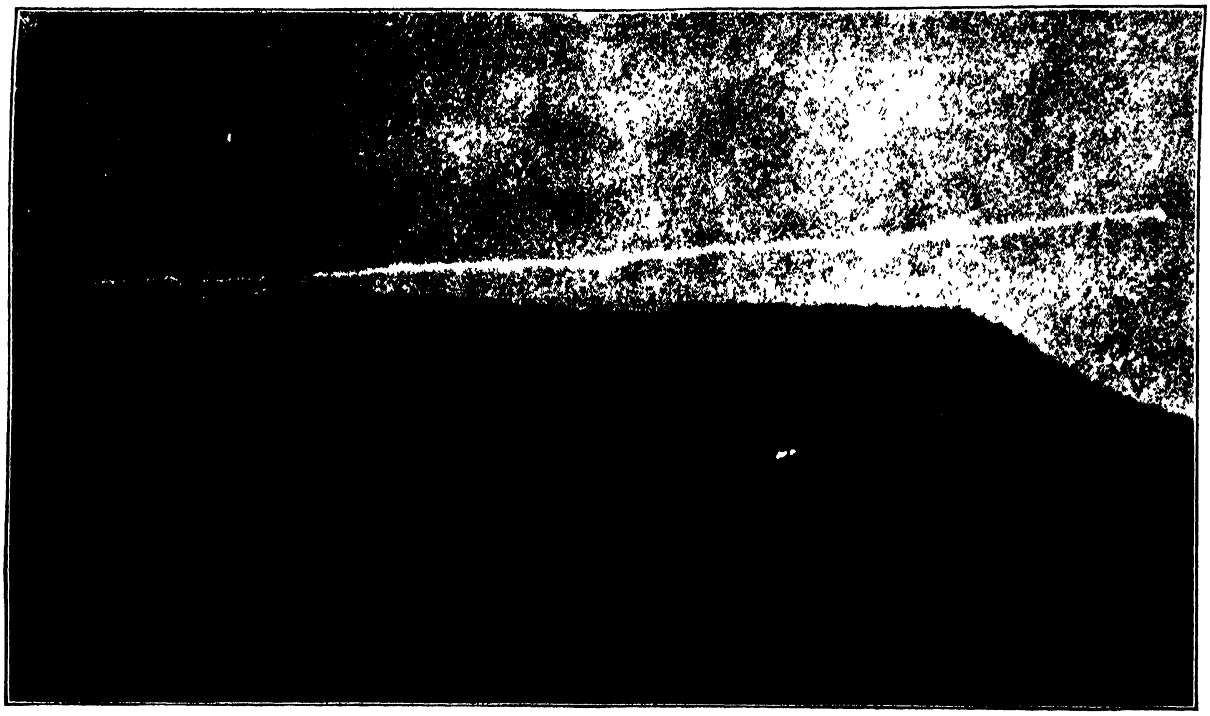
Figure 5: **Origin of fins from fin folds. *A:* Ventral fin of Devonian shark (*Cladoselache*), showing separate rod-like supports of "fin-fold" fin. *B:* Pectoral fin of the same, showing pectoral girdle and basal pieces presumably derived from fusion of separate rods. *C:* Pectoral fin of Permian shark (*Pleuracanthus*), showing fully developed paddle-like fin with jointed axis. *D:* Pectoral fin of Devonian shark (*Cladoselache*), partly covered by preserved myomeres. *E:* Restoration of generalized shark**

The fins in the most ancient and primitive known fishes, the sharks of the Devonian period (Figure 5), were merely stiff folds of skin which were slightly warped by the zigzag muscles of the flanks, and mainly served as keels and rudders to steady and direct the forward progress of the fish. In some of the higher fishes, on the other hand, the bony rods that supported the paired fins fused into a skeleton that appears to have been the starting-point of the complex shoulder-girdle and fore limbs of land-living vertebrates. The pelvic fins of fishes bear even clearer traces of their derivation from keel-like fin-folds, the bases of which became invaded by outgrowths from the segmental muscles of the body (Figure 5, A).

DURING the embryonic development of all higher vertebrates, including man, the fore and hind limbs develop from bud-like outgrowths involving folds of skin from the body wall and an extension of the segmental muscles of the flanks.

In short, the detailed evidence of comparative anatomy leaves no substantial doubt that upright-walking man has derived all four of his limbs from the corresponding organs of some early four-footed animals, that these quadrupeds derived their limbs from the paired paddles of certain types of air-breathing, lobe-finned fishes, and that they in turn derived their paddles from the simple fin-folds of still earlier shark-like fishes. Such were the "basic patents" of our motor system.

(To be continued)



It is a commonplace that we "see the sun after it actually has set," due to the bending of its rays (atmospheric refraction) by the earth's atmosphere. Above is a photograph of the trail of the star *Alpha Centauri*, made by time exposure in a 24-inch fixed telescopic camera by Professor W. J. Luyten of Harvard's South African observatory. The star dips behind the theoretical horizon by as much as the diameter of the moon, yet is visible above it due to refraction. The telescope, of course, is not moved

The "Green Flash" and Other Odd Phenomena

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

As one watches the setting sun, it sometimes takes strange forms. Always when it is low on the horizon it appears flattened, with its vertical diameter considerably shorter than the horizontal, and just before the lowest point of the rim disappears it may be noticed that the lower half of the disk appears more flattened than the upper. These are normal phenomena which can be seen whenever clear weather and the free horizon permit, but not infrequently—especially when the sun goes down into the sea—its shape may seem strangely distorted. At times the lower half may look larger vertically than the upper, so that the partly set sun looks like a Chinese lantern. The likeness often is emphasized by the appearance of little corrugations in the outline of the upper dome-like half. On other occasions the top of the sinking sun, instead of disappearing quickly, seems to hang on the horizon as a fine horizontal line of light.

It is not the sun alone which shows these strange vagaries. A distant coastline may look distorted. Low sand banks sometimes seem expanded into high cliffs or a long line of distant coast which normally runs out at the horizon, may seem to end in the air with a narrow line looking like sky, separating it from the sea surface below. Ships on the horizon or beyond it, too, are often absurdly distorted, so that only the experienced sailor long familiar with the effects of what he calls "looming" has any real idea of what sort of craft it may be at which he is looking.

Most remarkable of all are the things that are seen upon the desert.* A level stretch of hot sand may appear to be covered with water, reflecting not only the sky but the barren hills beyond and producing a perfect illusion—as the writer has seen it within a few days on the sandy wastes of Nubia.

These more conspicuous phenomena, whether on land or sea, are grouped under the general name of mirage. Though visible and sometimes conspicuous to the unaided eye, they usually show up better with a field glass of low power. But when a high-powered glass is used—much more a telescope—the image is found to be so blurred and trembling that very little can be made out. Just at the edge of the mirage, indeed, the bad definition is often perceptible even by the naked eye.

All this is interesting, surely, to the traveler but what has it to do with astronomy? "Much every way," as Saint Paul once said—it is the most spectacular exhibition of something with which the astronomer has to reckon in all his observations—namely, the refraction of light in the atmosphere.

In empty space all the waves of light travel with the same standard speed but in air they are retarded, and the more so the denser the air. As a result the "rays" of light—that is to say lines drawn at right angles to the waves and indicating in what direction the

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*Dr. Russell's article was written in Egypt, where he had just seen some of the phenomena described in it.—*The Editor.*

latter are moving—are usually curved when passing through the air, instead of straight as they are outside in space. One simple rule suffices for an understanding of most of the numerous effects of such refraction. The rays of light always curve toward the side on which the air is denser. Why this happens can be seen at once from Figure 1, which represents a number of successive positions aa′, bb′, and so on, of the crest of a light wave. The air is supposed to be denser toward the bottom of the picture than toward the top, hence the distances ab, bc, and so on, through which the light wave moves, will be greater than a′b′, b′c′, and so on (the effect is of course vastly exaggerated in the figure). The rays of light XY and X′Y′, which are drawn so as to be always at right angles to the waves, will therefore curve downward; that is, toward the denser air.

UNDER normal circumstances the air grows steadily denser downward from great heights to the earth's surface. Hence the rays of light curve downward and the direction in which they enter our telescope or our eyes is altered so that we see the sun, moon and stars higher in the sky than they would appear were there no atmosphere.

The more obliquely the rays traverse the air the greater is this effect. At considerable altitudes the shift of apparent position by this "astronomical refractor" is not very large - about a minute of arc at 45 degrees altitude. In all accurate observations, of course, it must be carefully allowed for—which is laborious since its amount varies with the pressure and temperature of the air. Near the horizon the refraction becomes large, amounting at rising and setting to more than half a degree. For bodies only a little higher, its amount is considerably reduced. When the sun is setting, therefore, the rays from its lower side are more curved than the less oblique rays from its upper side, the lower limb appears to be raised more than the upper, and the disk seems flattened. It may be noted in passing that refraction makes the sun set later than it would otherwise do, and rise earlier, since it raises the sun in both cases, so that the day gains about 5 minutes in length in temperate latitudes at the expense of the night.

Before leaving this normal refraction we may mention an interesting effect which, though of the "second order" depending on small changes in a quantity which itself is usually small, can be easily observed without instruments.

Shorter waves are more slowed by air than longer ones, and hence the rays of red light are curved least and the violet most. When the sun is low, therefore, it appears to be raised a little higher if seen by green light than by red, and if viewed through a telescope its disk shows a greenish border at the top and a reddish one at the bottom (the violet is always lost in coming through so great a thickness of air). This border is far too narrow to be seen by the unaided eye, but just as the sun sets the green image remains in sight for an instant after the red and yellow have disappeared, so that under favorable conditions the last speck of sunlight can be seen to turn from yellowish red to green.

This "green flash" (Figure 2) is a normal phenomenon and can be seen unless something interferes. Unfortunately a good many things may interfere. The air, of course, must be clear and free from haze There is little hope of seeing it unless the setting sun looks yellow rather than red, and is too bright to look at without dazzling the eyes. The horizon must be fairly distant, sharp, and at a low altitude. A sea horizon or a low distant range is the best. Finally the eye must not be fatigued by gazing at the brilliant disk before it sets. A mere glance now and then to see how things are going is all that the observer should allow himself until hardly more than a speck of the sun remains. Granting these conditions the green flash is visible under a great variety of conditions. It is better seen with a field glass than without. At sunrise, of course, it is equally well visible, with the advantage that the eye is not tired, and the disadvantage that one must keep a sharp watch not to miss it.

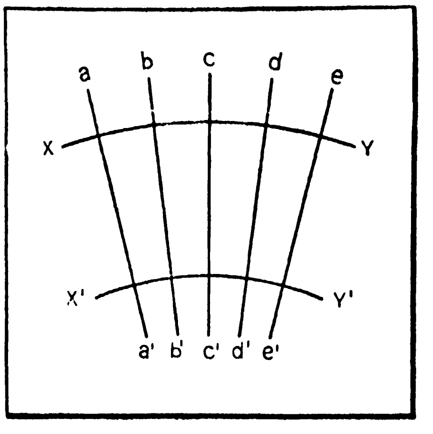


Figure 1: **Explaining the cause of refraction or bending of light. See the explanation in the text**

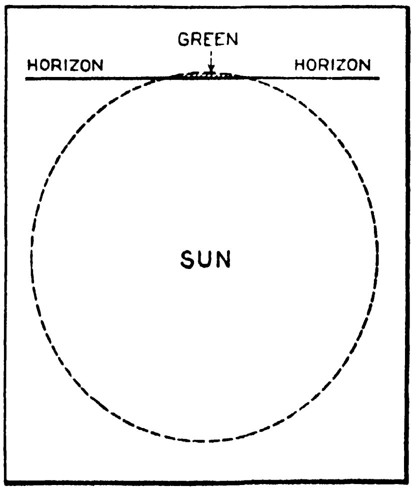
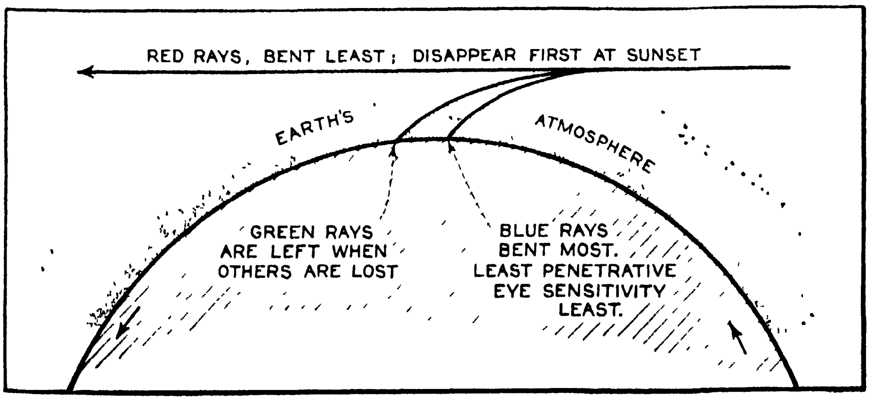


Figure 2: **The phenomenon of the green flash is not especially spectacular; it occurs when less than 1/100 of the disk remains in view (right). Below is the explanation of the effect (diagrammatic)**


RED RAYS, BENT LEAST; DISAPPEAR FIRST AT SUNSET
EARTH'S
ATMOSPHERE
GREEN RAYS ARE LEFT WHEN OTHERS ARE LOST
BLUE RAYS BENT MOST. LEAST PENETRATIVE EYE SENSITIVITY LEAST.

MIRAGE, including in this term all the protean forms of distorted images of celestial and terrestrial objects, arises from abnormalities of refraction mainly if not entirely due to irregular distribution of temperature within the air. The normal and gradual increase of density downward is due mainly to the increase of atmospheric pressure. To be sure, the air is warmer low down than higher up; and this works the other way, though under ordinary conditions to a much smaller degree than the change in pressure.

When, however, the earth's surface, whether land or water, is considerably hotter than the air at large and the weather is cooler, a thin layer of air just above the surface may be heated so much that it becomes considerably less dense than the overlying cool air, even though it is at a slightly higher pressure Rays of light passing through this stratum will be curved upward, as illustrated in Figure 3, which shows how the illusion of a sheet of water filling a desert plane will be created. The distant object A is seen by the observer at O, through the upper layer of normal air, by light which follows the path AaO, which is curved very slightly downward. Light rays traversing the layers of hot air near the surface indicated by the lower lines will

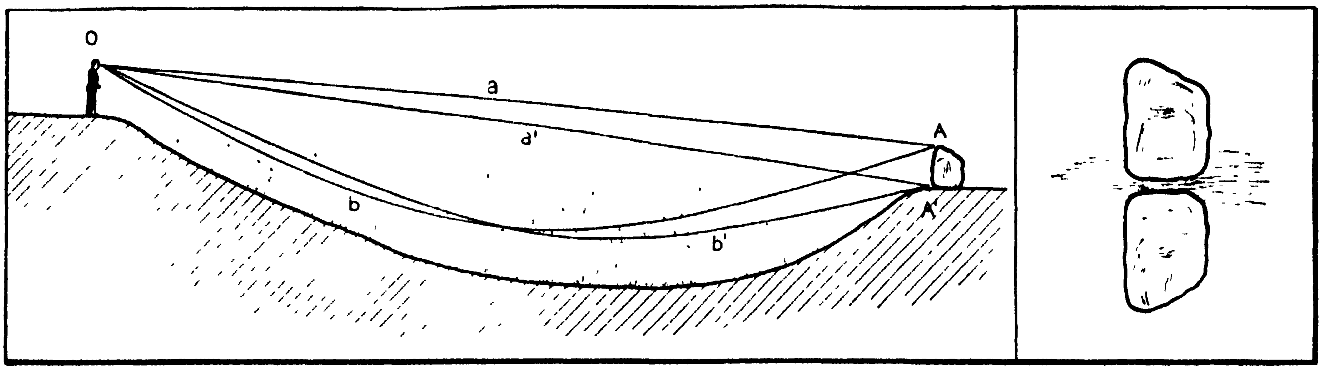


Figure 3: **Explaining the familiar illusion of a lake on a desert, also at right the rock at A is seen doubled, a "superior mirage"; see Humphrey's "Physics of the Air," standard work in which peculiar phenomena are treated**

be curved strongly upward so that the observer may see a second image of A, caused by light which has followed the path AbO. The base A' of the object will be seen both along the rays A'a'O and A'b'O, so that the observer will see two images, one erect and in its normal position and another inverted and lying below it as if reflected in a sheet of water filling the valley.

Mirages appear most typically under two very different conditions: first, on land where the bare surface of the ground is highly heated by the sun, and secondly at sea where the vicissitudes of the weather bring cooler air over warmer water. The first situation is characteristic of desert regions, but one need not go to the borders of the Sahara nor to Death Valley to find it. Almost any bed of level railroad track on a calm sunny day will suffice, and a stretch of level oiled highway still retaining the heat of the sun though the air above has cooled after nightfall, does even better. Most of us have seen a distant locomotive looking twice as high as it should, and it is a common thing looking from an observation tower to see the space between the rails apparently filled with water. Almost all of us, too, have seen the lights of an approaching car half a mile or so away apparently refracted from the pavement of the road; and all these are as truly examples of mirage as the proverbial "lakes" in the desert.

ALONG our coasts, too, when the autumn days and evenings are cool and the water still retains its summer heat, distant shores seem lifted into the air, ships are strangely distorted, and far-away light-houses show double lights one above the other. No one can live long by the water without seeing these things, but not so many understand them.

Another effect of these anomalies of refraction is that the distance of the horizon at sea, or of the farthest objects that are visible on land, may be very different on different days, or even at different hours of the same day How this happens is again best understood from the diagram. Figure 4 almost explains itself. In the absence of refraction the rays of light are straight and the horizon at A. When there is a stratum of hot air close to the surface the rays curve upward and the horizon is nearer at B, but when the air near the surface is abnormally cold the rays curve downward and the horizon is shifted to C.

It is clear from the figure that not only the distance but the apparent direction of the horizon is altered. As a result the dip of the horizon, for which allowance has been made in all observations, may differ perceptibly from the standard value given on the tables employed by mariners. The error arising from this cause is often a good deal larger than any other which occurs in careful observations with a good sextant, and it sets a limit to the accuracy of determination of longitude and latitude at sea; but fortunately the uncertainty arising from the cause is usually less than the distance which the ship would run while the captain is "working his sights," and so it is not of practical importance.

THE diminished distance of the horizon under mirage conditions is not very noticeable, but the increase when the air is cold close to the ground may be very remarkable. On the Texas prairies, where the ground is as level as the sea, and distant buildings look like ships "hull down," the writer has seen just before sunrise houses and farms which were ordinarily quite invisible. Within a few minutes after the sun's rays warmed the ground these began to settle down into the horizon and before long they had quite disappeared. Under these conditions in clear weather the mariner may see light houses which normally would be far beyond the horizon.

The most remarkable instance of refraction which the writer has seen happened one afternoon in a New England harbor when the sea horizon was clearly visible above the top of a house on an outer beach, although the observer in a small motor boat had his eyes less than six feet above the water. In this case the downward curvature of the rays must have been so great that, although passing above the house (fully 30 feet above sea level), they bent down to the water within a few miles on each side.

IF the layers of warmer air were horizontal and absolutely calm the reflected or distorted images of a mirage would be sharp and clear, but even in the stillest weather there is always more or less stirring of the air, if only by currents arising from the hot ground, and this turbulence confuses and disturbs the images so that they bear at best only a low magnifying power. This is but an extreme instance of the "bad seeing" which is always more or less present and is so troublesome to the telescopic observer. If the atmosphere were visible like water, its turbulence then would be far more impressive than it is. In comparison the wild turbulence of Niagara Rapids would seem quite tame.

All the phenomena of atmospheric refraction, whether normal or abnormal, are an unmitigated nuisance to the astronomer but they are so varied, so curious, and so easily to be seen if one is on the watch for them that some knowledge of them may add interest and pleasure to a summer vacation.

Luxor, Egypt.

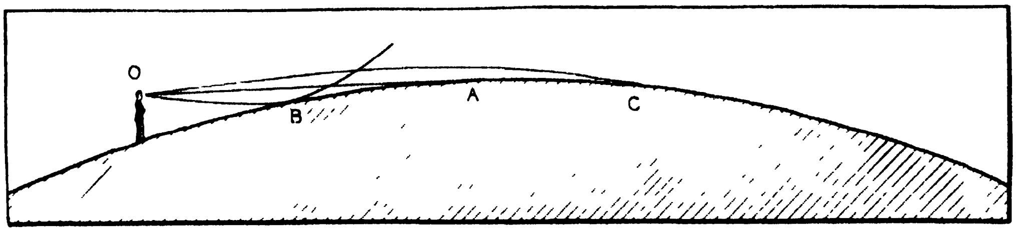


Figure 4: **Why different temperature effects cause the horizon to vary in distance**

The electrical photographing mechanism is automatic. The photograph is taken through a screen and it, in turn, is viewed through a screen

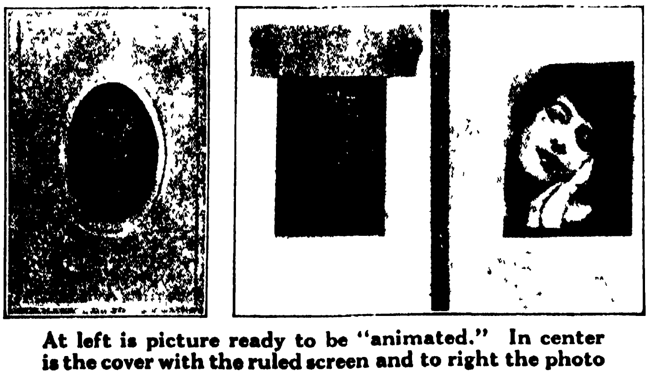
Film Yourself for a Quarter

The would-be movie star sits in the booth and the face is well lighted

THE theatrical business is precarious at best and "flops" are common so that there is little wonder in a producer taking a flyer on stocks or in an invention, particularly in something which has a very popular appeal. Mr. A. H. Woods is one of these producers who is backing a very clever device that makes simulated motion pictures of subjects while they wait. Mr. Woods obtained the rights in an English invention a few years ago but the time required to produce the picture was inordinately long. For the past two years Mr. Stanley J. Pask, a practical camera man, has been making the device commercially marketable. The pictures may be radically different—thus you may smoke, use a telephone, or take a group of a family of three, and each can be animated in turn.

The new camera is very complicated and only a brief outline of the cycle of operations will be given. Three (or more) pictures are taken on one plate film through a screen composed in part of transparent material and in other parts, of opaque material. The screen is positioned directly in front of and resting against the sensitized film and with the object to be photographed focused properly in front and illuminated by a powerful electric light, so that at least three exposures may be made. The screen is shifted at each exposure, the person being photographed changing position. The person sits on a stool in a booth fixed up like a dressing room. The idea is to take the photographs so that they will give some idea of how he or she will "screen."

ONCE in position the attendant presses a plunger and the cycle of operations begins. After the three exposures are made, the sensitized film is developed automatically in the machine in 12 seconds and we have what appears to be an ordinary photograph except that it is ruled with almost invisible vertical lines. This is mounted in a pasteboard frame 2¾ by 4 inches and a cover of the same material is provided with a cut out window to which is attached a vertically ruled film. The two pieces of cardboard, one holding the photograph and the other the film, are loosely attached so that there can be lateral movement. If the sides of the mount are pinched slightly, the picture is "animated" giving the effect of a moving picture, which is most amusing. These booths will soon take their places where amusement devices are shown, and in theater lobbies.



At left is picture ready to be "animated." In center is the cover with the ruled screen and to right the photo

Gathering petals for perfume in the Balkans. Egypt, too, produces fine flower oils to a growing extent

Perfume

By MARTIN MEYER, Ph.D.

Assistant Professor of Chemistry, College of the City of New York

THE sense of smell is one of the human functions which not only has failed to advance with evolution but which in many respects has actually deteriorated with the increase of civilization. The dog distinguishes friend from enemy by the smell, and can track a man over a long period from the mere recollection of the odor of one of his articles of clothing. Wild animals scent danger at incredible distances where no explanation save smell or intuition is forthcoming.

The human animal no longer possesses this delicate perception. He can distinguish agreeable odors from disagreeable ones, but the very language itself expresses the atrophy that has occurred. One does not have to be exceptionally well skilled in the use of words to be able to describe a scene so accurately that another who has seen it will recognize it or, not having seen it, would later feel familiar with it. With a smell, however, this is quite impossible. Try to depict in words the most familiar fragrance, that of the rose, for example, so that a hearer will know it, without employing words such as "rose-like," which suggest the object described. Your effort will certainly be a failure.

Perfumes are solutions of essential oils and other fragrant materials in slightly diluted alcohol or spirits, while those of the ancients were merely the odoriferous materials themselves.

Essential oils are interesting substances indeed. They are all obtained from vegetable sources, occurring in the flowers, leaves, stems, and roots of plants, and are extracted by highly ingenious methods. They derive their general name from the fact that all are oily materials in the sense that they are usually lighter than water and float on its surface but do not mix with it. They also resemble other oils in that they will form a greasy spot on a piece of paper, but they differ from the so-called fixed oils, in that this spot disappears or evaporates completely on standing, whereas the others do not. Not all have pleasant or even agreeable odors.

OTHER perfumery materials, and some of the most expensive, are obtained from animals. Ambergris, a highly prized perfumery component, is found occasionally in large lumps on the seashore, washed in by the waves. It is a material emitted by sick whales. Musk is obtained from a variety of oriental deer, now nearly extinct, because of the merciless hunt for it, and civet, another valued fragrant essence, from a member of the cat family, in ways that have nearly exterminated the species.

Some of the flowers yield their essential oils simply by pressing the petals, but the yield is extremely small. A ton of flowers may give only an ounce or two of the desired perfume material. Other oils may be obtained by extracting them with alcohol or other solvents.

Steam distillation is yet another method employed in coaxing flowers to yield the secret of their gorgeous fragrance. The flowers are macerated with water, and then steam is passed through the mixture and the escaping vapors are condensed. The essential oil floats upon the surface and can be separated and used in making perfumes, while the residual water itself retains enough of the oil in solution to be highly fragrant and has commercial value. Oil of roses can be made in this way, and the remaining liquid is sold as rose-water. In France they employ an interesting process termed *enfleurage*. In that land, growing flowers is a branch of agriculture conducted on a scale comparable with the raising of the cereal grains. One of the greatest beauties of southern France is the large flower fields in bloom. Fats and oils possess the property of absorbing odors to a marked degree; every housewife knows the result of placing butter in the icebox with fish, and in *enfleurage* the petals of the flowers in full bloom are packed in a box on shelves between pans of a very pure fat which slowly absorbs this fragrance. The essential oil then may be extracted from the fat and used for perfumes, or the fat itself may be made into pomade. The yield of essence by this method is extremely small but its quality is very high.

ESSENTIAL oils and perfumery materials are high-priced articles of commerce but they rarely reach the retail trade. They are made or purchased by the manufacturer of perfumes. In price they vary from a few dollars an ounce to hundreds of dollars a pound, and many of them are literally worth more than their weight in gold. Perfumes are made by dissolving them in alcohol, and as a rule a perfume does not contain more than 10 percent by volume of essential oil.

Usually perfumes do not consist of a single essential oil dissolved in alcohol. Therein lies the secret of their manufacture, for the blending of the oils to make the commercial odors is a delicate art and a closely guarded secret of the firms which have become world-famous. Some of the formulas, such as the famous German Cologne water, have been in the sole possession of single families for generations and to obtain them is impossible. They are available neither in the interests of science nor for any price.

A chemist named Piess once devised the interesting scheme of likening the odors to the musical scale, and made up a keyboard on which the lower notes were represented by the heavy oriental odors such as patchouli, ylang-

ylang, and sandalwood, rising to the lighter and more evanescent ones like rose and heliotrope. On this fascinating scale one could play odor symphonies like a musician, for musical accords represented agreeable combinations, and discords incompatible mixtures. The device was, of course, purely of academic interest for there is no mechanical rule by which perfume formulas can be originated. Mixing of essential oils to form fragrances which will strike the popular fancy is an art requiring a delicacy of perception that doubtless can be acquired only by long experience.

The manufacture of perfumes is a field in which the chemist finds a very agreeable opportunity to display his talent and his ingenuity, and he already has done so with a marked degree of success. Usually the chemical laboratory is a place distinguished by odors that are proverbially vile beyond description. The perfume laboratory is truly a garden of roses, for practically every material which enters into their manufacture, as well as the perfumes themselves, have highly aromatic agreeable odors.

WITHOUT the chemist, perfumes would still be far too expensive to be used as generally as they are, even though they are still relatively costly. The cheapest of them which contain any considerable quantity of natural essences sell for three to five dollars an ounce, and 25 dollars is not unusual.

In the case of the most expensive of all, the rôle of the chemist is best illustrated. Natural violet perfume is the rarest and most costly of all the fragrances in the perfumer's bouquet. An acre of violets yields only a few drops of the essential oil which is this essence, and it is exceedingly difficult to obtain and keep. By careful analysis it has been determined that the chief component of violet oil is a chemical substance called ionone. When pure, this material is so powerfully fragrant that it paralyzes the sense of smell completely and seems odorless, a phenomenon which is not unusual with strong solutions of highly odoriferous substances. Synthetic organic chemistry has shown how to make ionone very cheaply and violet perfume so made is now among the cheapest of all. This is so true that natural violet perfume scarcely can be obtained, for it can not compete with the five-and-ten-cent-store variety with which the untrained taste, or rather, smell, so easily confuses it.

Among the other triumphs of the chemist of a similar nature have been methyl salicylate, identical with the chief component of natural oil of wintergreen; coumarin; geraniol, characteristic of roses; citral; musk; and many others. The products of the chemists' laboratory can not, however, be used alone in any but the cheapest perfumes. While they have very powerful odors identical in many cases with the principal substances in the natural essential oil, the discriminating sense can easily distinguish the many other components which shade so delicately the perfume made from a natural flower.

THESE do, however, make perfumes cheaper to manufacture because they can be used to replace part of the true essential oil, which then gives the bouquet which surrounds and enriches the principal odor. Practically no perfumes as sold today are without synthetic organic products, yet on the other hand, none, save the very cheapest, is completely synthetic.

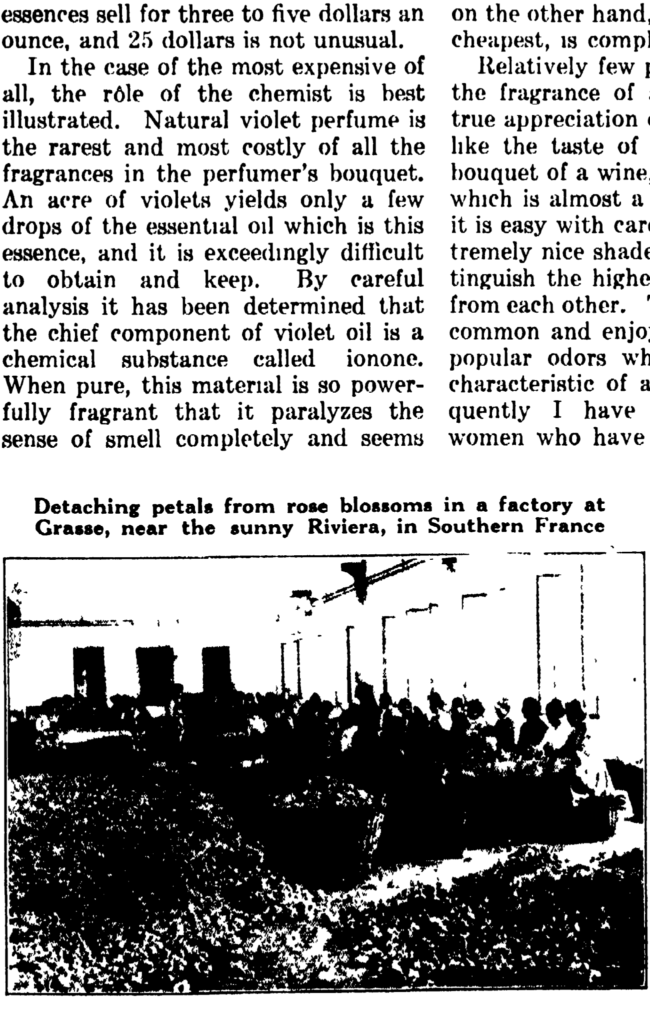
Relatively few people seem to enjoy the fragrance of a perfume with the true appreciation of a connoisseur yet, like the taste of tobacco or the fine bouquet of a wine, the appreciation of which is almost a lost art in America, it is easy with care to perceive the extremely nice shades of odor which distinguish the higher grades of perfume from each other. This is especially uncommon and enjoyable in the case of popular odors which are blends not characteristic of any one flower. Frequently I have experimented with women who have used the same and expensive odor of perfume for many years. After modifying the perfume so that the chief odor remains the same, as well as the color, though the difference was easily perceptible to one who had carefully observed, I have presented it to them in the expected package and bottle, and they often not only fail to detect the deception, but compliment me upon the fact that it appears fresher because it is stronger and more lasting. With age perfumes do change in color and in odor.

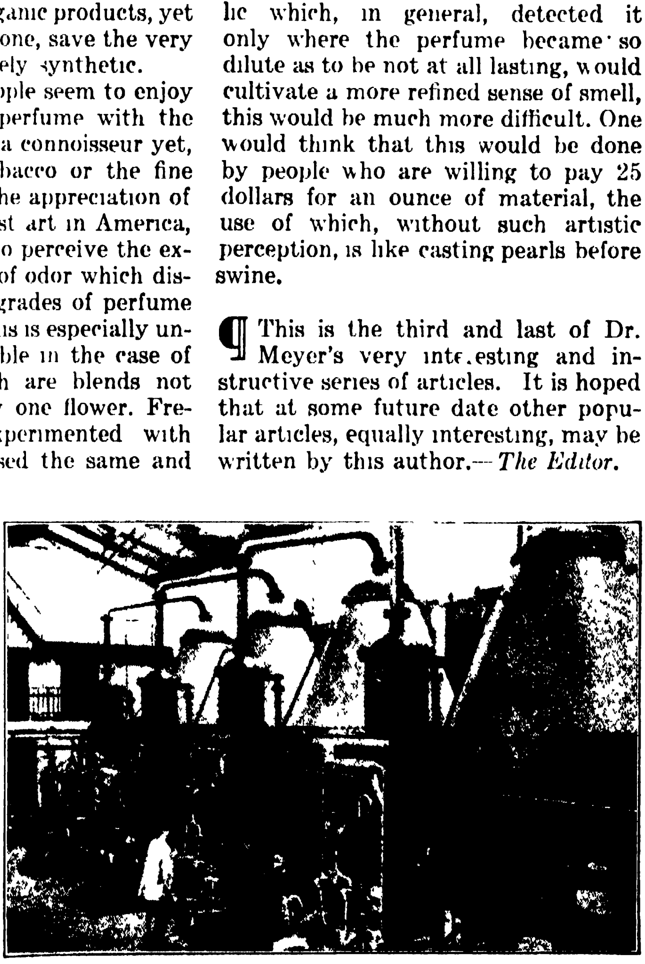
IT is interesting to note that here, too, as in the case of any rare and expensive commodity, the practice of bootlegging flourishes and is very profitable. Rare ingenuity is sometimes exhibited, running from the comparatively crude device of diluting the original perfumes with alcohol and cheaper perfumery materials, to complete and spurious imitation of the original product. In the case of two or three internationally known perfume manufacturers, especially in purported re-bottled perfumes, this has been perpetrated so extensively and unconscionably that it has damaged considerably the widely advertised and wholly deserved name.

Careful chemical study established the nature of the devices used and strenuous methods have been adopted to stop the deception, but if the public which, in general, detected it only where the perfume became so dilute as to be not at all lasting, would cultivate a more refined sense of smell, this would be much more difficult. One would think that this would be done by people who are willing to pay 25 dollars for an ounce of material, the use of which, without such artistic perception, is like casting pearls before swine.

¶ This is the third and last of Dr. Meyer's very interesting and instructive series of articles. It is hoped that at some future date other popular articles, equally interesting, may be written by this author.—*The Editor.*

Detaching petals from rose blossoms in a factory at Grasse, near the sunny Riviera, in Southern France





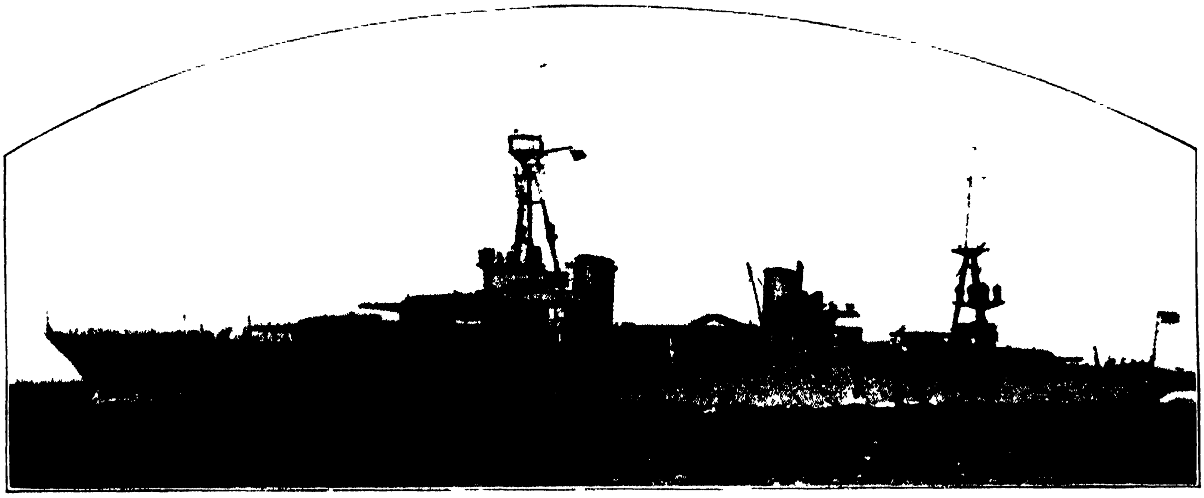
Distilleries in a perfume factory at Grasse. Here the detached rose petals surrender their fine fragrance

The Eight-Inch Gun Cruiser

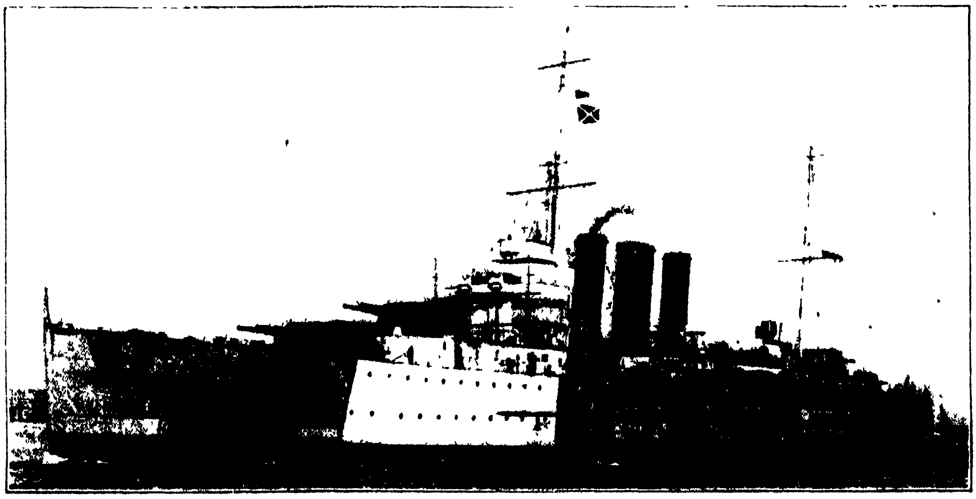
By CAPTAIN W. D. PULESTON, U.S.N.

At the close of the Revolutionary War the Continental Navy was disbanded. Due to attacks of the Barbary pirates on our commerce in 1794, Washington recommended and Congress authorized the construction of six frigates. This was our first building program as an independent state. General Knox, Secretary of War and Navy, decided that these frigates "should combine such qualities of strength, durability, swiftness of sailing, and force as to render them equal if not superior" to any European frigates. The results of the battles between frigates during our wars with France and England indicated that American designers measurably succeeded in their object. President Roosevelt voiced the same idea in his demand that the American Navy "ship for ship" must be better than any other in the world.

The era of wooden ships culminated in two principal naval vessels ships of the line displacing 1300 to 3100 tons, carrying 60 to 120 guns, and maximum speed of 12 to 13 knots; and frigates displacing from 650 to 1300 tons, carrying 32 to 50 guns and capable of outsailing the ships of the line, except in heavy weather. In addition to these were sloops of war and fire-ships corresponding to our light cruisers and destroyers, and bomb-ketches especially designed for use against shore defenses.



U. S. S. *Northampton*



H. M. S. *London* ➤

The advent of the steam engine, the paddle-wheel, and the screw propeller gradually gave a reliability to naval motive power entirely lacking in the sailing vessels. The iron and steel industry furnished the naval designer with material that permitted greater freedom in design than wood.

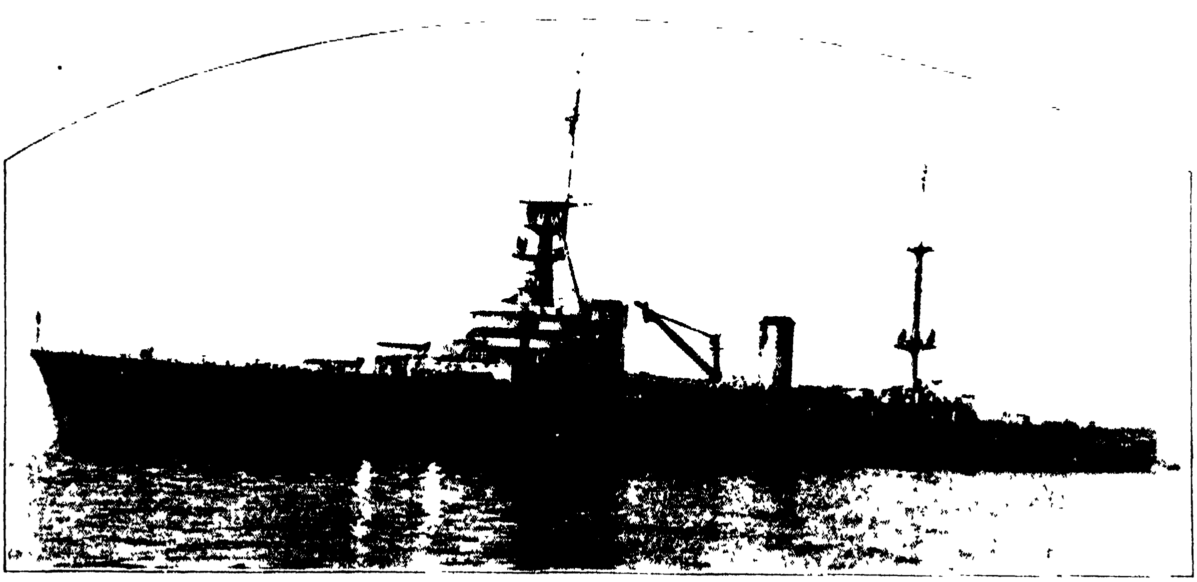
The great advantages of seapower were early known to Europeans, and modern European states, particularly from 1870 onward, demanded navies, and gave an increasing impetus to naval design that continued to the Washington Conference in 1921-22.

The weapon builders and the armor manufacturers responded to the urge, and the development of the gun, the mine, and the torpedo, and the improvement in armor and compartmentation of ships, proceeded apace. After the Spanish-American War we began to build a fleet. The submarine and the airplane made their appearance to complicate the task of the naval designers further, and the World War accelerated the natural rate of improvements of all naval weapons and vessels as nothing else has ever done.

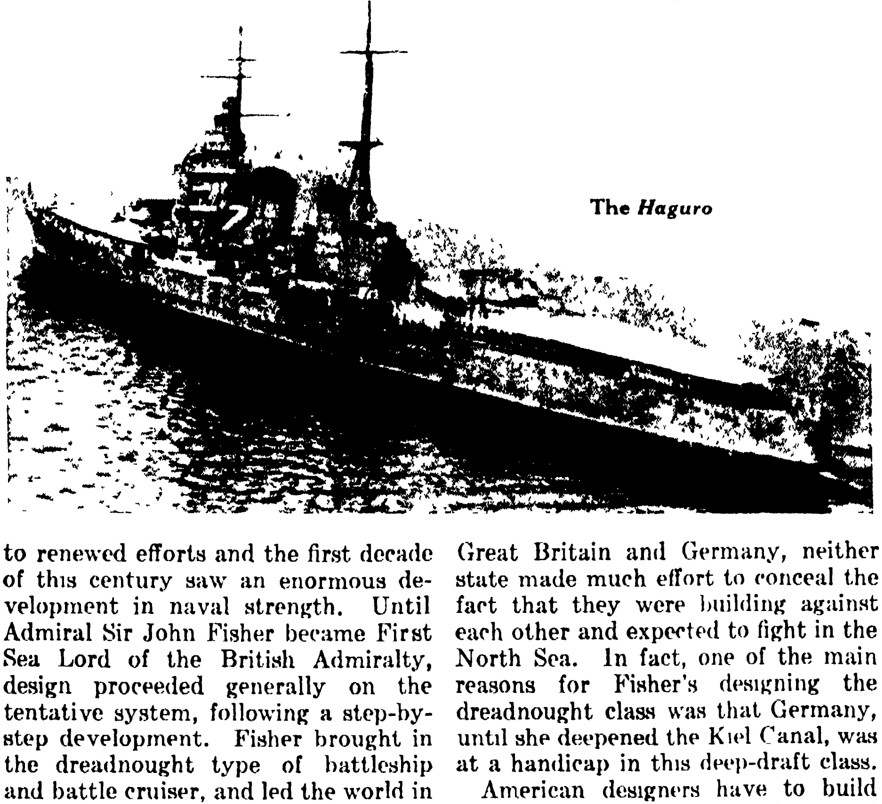
For over a century of design, naval constructors generally and American particularly, following the idea of General Knox, have struggled to obtain three almost unattainable attributes --invulnerability, omnipotency, and omnipresence. They sought an unsinkable ship, an irresistible ship, and a ubiquitous ship. Together with their ordnance and engineering designers, they strove to create a ship that could resist any other, run down any other, and sink any other ship. In the same plant, the ordnance manufacturer would seek to develop impenetrable armor and an armor-piercing projectile.

THIS competition led to continued increase of tonnage because designers soon discovered increased size gave them a still greater corresponding increase in offensive and defensive values. There naturally followed a constant increase in size of all types of ships.

Mahan's widely read books on the advantage of command of the sea spurred the great powers, particularly Great Britain and Germany,



The *Duquesne*



The *Haguro*

to renewed efforts and the first decade of this century saw an enormous development in naval strength. Until Admiral Sir John Fisher became First Sea Lord of the British Admiralty, design proceeded generally on the tentative system, following a step-by-step development. Fisher brought in the dreadnought type of battleship and battle cruiser, and led the world in the pre-war design; other countries quickly followed his example. The British pre-war design culminated in the battleships of the Royal Sovereign class, the battle cruisers of the Tiger class, and the so-called battleships of the Queen Elizabeth class whose 25 knots made them practically battle cruisers. The progressive design of battleship and battle cruiser almost met in the Queen Elizabeth class, as shown by the following table:

	Tons	Speed	Guns	Armor	Protective Deck
Queen Elizabeth	27,500	25	8 15"	13"	1" to 3"
Tiger.	28,500	30	8-13 5"	9"	1" to 3"

This table also shows the great cost of the last few knots; thus for five knots extra speed, the battle cruiser *Tiger* conceded the *Queen Elizabeth* 4 inches of armor belt and 15-inch guns instead of 13.5 inches.

In the naval competition between Great Britain and Germany, neither state made much effort to conceal the fact that they were building against each other and expected to fight in the North Sea. In fact, one of the main reasons for Fisher's designing the dreadnought class was that Germany, until she deepened the Kiel Canal, was at a handicap in this deep-draft class.

American designers have to build their vessels for service in all parts of the world; and with no hereditary enemy, they have to design vessels for more than one purpose and fit them for duty in any part of the world.

OUR 1916 naval program provided for ten superdreadnought battleships and six battle cruisers. We kept our battleship types quite distinct from the battle-cruiser type, not attempting the great increase in speed in our battleships attained by Great Britain. So did Japan, although generally speaking, the designed speed of her battleships has exceeded ours.

The first modern limitation on the size of all naval vessels was the dimensions of the locks of the Panama Canal. This fixed absolutely the maximum outside limits of American ships and practically fixed it for other navies that will probably find the Canal useful, if not essential.

The Washington Conference placed the next limitation on naval design by creating a battleship holiday and by limiting cruiser displacement to 10,000 tons and armament to guns of 8-inch caliber. The battleship holiday, recently renewed at London, increased the importance of cruisers, destroyers, and submarines, and naval constructors concentrated their attention on the designs of these and aircraft carriers. The limitation placed on the tonnage and caliber of guns to be carried on cruisers left open to competition within very narrow bounds, the factors of speed, armor, and armament.

IN the previous competitions, designers had learned the great advantage of increased displacement and heavy caliber guns, so most naval constructors went at once to the 10,000-ton, 8-inch gun cruiser, with slight variations in speed and protection, depending upon the ideas of the line officers, the skill of the naval constructors, the efficiency of the establishments furnishing the materials going into the construction, and the available appropriations. It is significant that competition in design was just as sharp as before, except that it was concentrated in certain types, and confined to prescribed displacements.

The art of naval construction had practically reached a parity in the leading naval countries before the Washington Conference suggested a combat parity and ratios instead of unlimited competition in design; and there is small difference in the quality of the shipbuilding materials available in first class countries, so that it is not surprising that the 8-inch gun treaty cruisers of the five leading nations have approximately the same characteristics. This is shown by the similarity in the 8-inch gun treaty

	U. S.	Gt Britain	Japan	France	Italy	Germany
	Northampton	*London*	*Haguro*	*Duquesne*	*Trento*	*Ersatz Preussen*
	1930	1929	1929	1929	1929	1929
Displacement (tons) (fully equipped without fuel or feed water)	10,000	10 000	10,000	10,000	10,000	10,000
Dimensions (feet)						
Length (over all)	600	633	630	626½	640	604
Beam	67	66	57	63	67½	66
Draft	19½	17 (std) 20 normal	16½	20¼	19	16
Ratio (length beam)	8.96	9.74	11.05	9.94	9.48	9.15
Armament						
Guns—						
Main Battery	9 8-inch 3 triple turrets	8 8-inch 4 twin turrets	10 8-inch 2 triple 2 twin turrets	8 8-inch 4 twin turrets	8 8-inch 4 twin turrets	6 11-inch 2 triple turrets
Secondary Battery	4 5-inch Anti-aircraft	4 4-inch Anti-aircraft	4 4.7-inch Anti-aircraft	8 3-inch Anti-aircraft	16 4-inch Anti-aircraft	
Torpedo Tubes	6 2-triple training	8 2-quadruple training	12 6-twin	6 2 triple training	8 4-twin fixed	
Airplanes	4	1	4	2	2 or 3	
Catapults	2	1	2	1	1	
Propulsion						
Speed	32.7 stabilized	32.25 stabilized	33 stabilized	35-36	35	26
Machinery	Geared turbines	Geared turbines	Geared turbines	Geared turbines	Geared turbines	Diesel engines
Horsepower	107,000	96,000	130 000	120,000	150 000	50 000 (shaft)
Boilers	8, oil	8, oil, Yarrow	12, oil	8, oil	12, oil	
Radius of Action	10 000 at 15 knots	11,000 at 12.5 (probable)	14 000 at 14/15 knots	5000 at 15 knots	?	10 000 at 20 knots
Complement						
Officers	15	40	?	30	43	?
Men	620	650	?	592	650	?

TABLE A

cruisers of the five nations in the accompanying Table A, in which for convenience of further comparison, is also included the German battleship *Ersatz Preussen*, which is limited by the Versailles Treaty to 10,000 tons displacement but the 11-inch guns the Germans used came as a surprise.

Table A indicates that the designers of Great Britain, the United States, and Japan have practically stabilized the speed at 32.5 knots and battery, while France and Italy are building 35-knot cruisers. They all burn oil and use geared turbines except Germany, who depends upon the Diesel internal combustion engine. This table again shows the price paid for the last few knots speed in cruisers; thus the *Ersatz Preussen* carries 11-inch guns, is comparatively heavily armored, and can make 26 knots, only 6½ knots less than the typical treaty cruiser with 8-inch guns and comparatively unarmored. There is a striking parallel in the relationship between the *Ersatz Preussen* and the Queen Elizabeth class of fast battleships, and the treaty cruisers and the Tiger class of battle cruisers.

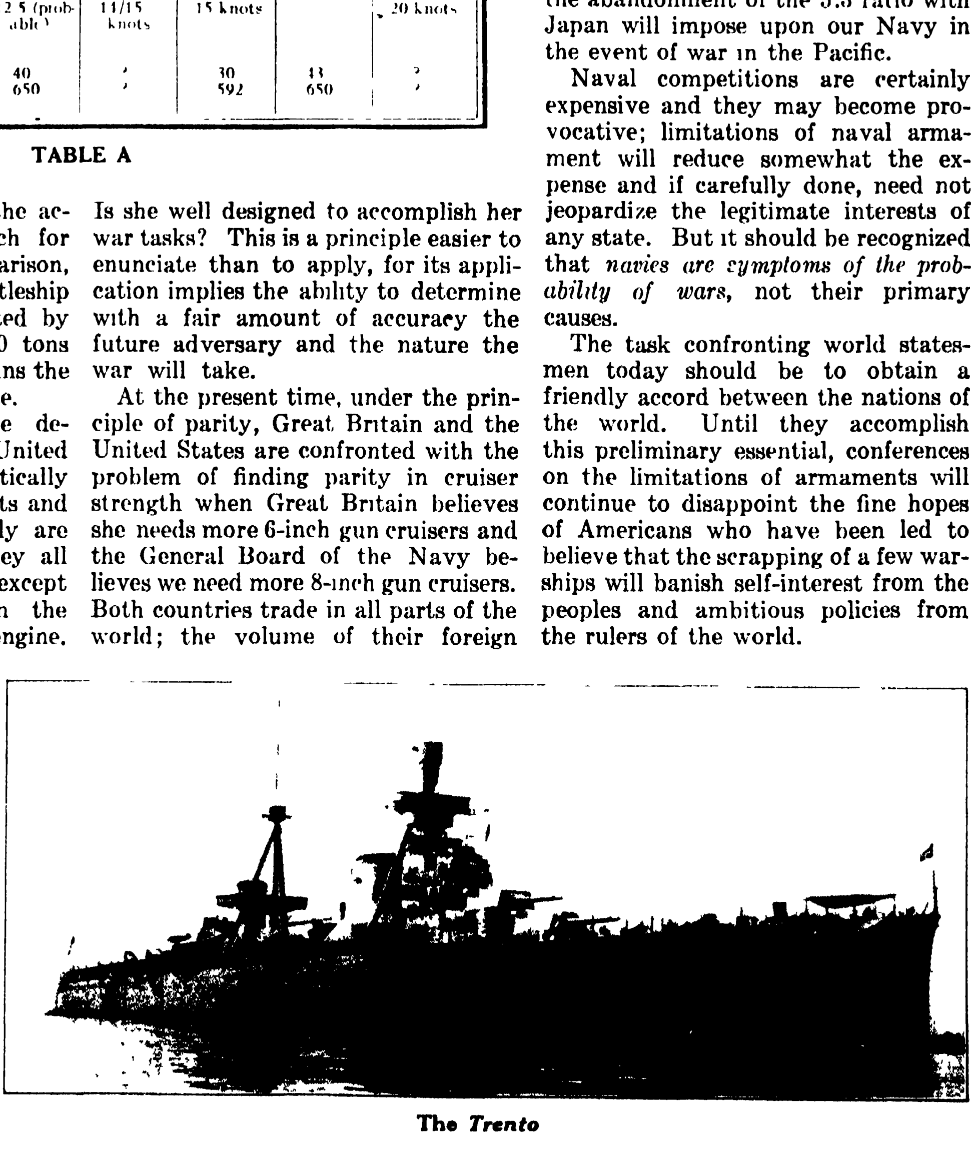
Mahan's test of a ship was: Is she well designed to accomplish her war tasks? This is a principle easier to enunciate than to apply, for its application implies the ability to determine with a fair amount of accuracy the future adversary and the nature the war will take.

At the present time, under the principle of parity, Great Britain and the United States are confronted with the problem of finding parity in cruiser strength when Great Britain believes she needs more 6-inch gun cruisers and the General Board of the Navy believes we need more 8-inch gun cruisers. Both countries trade in all parts of the world; the volume of their foreign trade over a period of five years is approximately the same; while Great Britain has more widely-spread dependencies, they are more strongly linked up by her numerous bases, whereas our water communications, even between our east and west coasts, pass directly in front of numerous foreign countries, so, generally speaking, it can be said that the naval burdens of the two countries in time of war will be approximately equal.

THE vital interests of Japan are much more closely concentrated than either American or British. She is an insular empire with adjacent continental possessions, very similar to England with French possessions under the Plantagenets. In addition to her navy she possesses the second or third largest army in the world. Accordingly, her naval ratio at Washington was made 5 to 3, and in return we agreed to cease fortifying our Far Eastern possessions. At London, substantial concessions were made to Japan, in cruisers and destroyers, and parity was given her in submarines. Members of the General Board have pointed out the additional handicaps the abandonment of the 5:3 ratio with Japan will impose upon our Navy in the event of war in the Pacific.

Naval competitions are certainly expensive and they may become provocative; limitations of naval armament will reduce somewhat the expense and if carefully done, need not jeopardize the legitimate interests of any state. But it should be recognized that *navies are symptoms of the probability of wars*, not their primary causes.

The task confronting world statesmen today should be to obtain a friendly accord between the nations of the world. Until they accomplish this preliminary essential, conferences on the limitations of armaments will continue to disappoint the fine hopes of Americans who have been led to believe that the scrapping of a few warships will banish self-interest from the peoples and ambitious policies from the rulers of the world.



The *Trento*

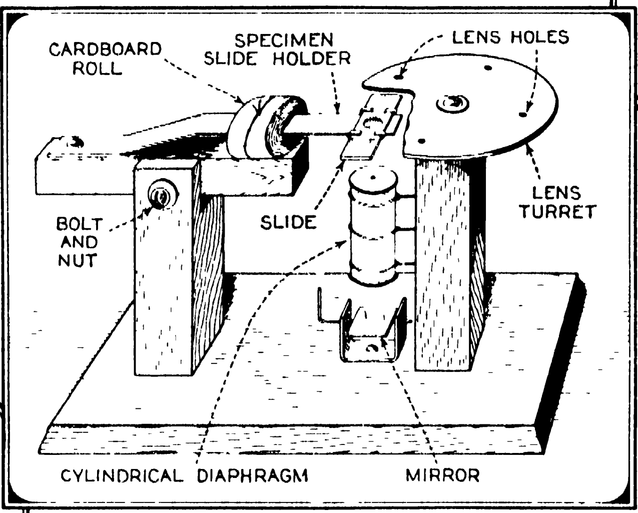
A Home Made Microscope for the Amateur

By LEON J. ISRAELOVITCH
Associate Editor Science and Engineering, Leningrad

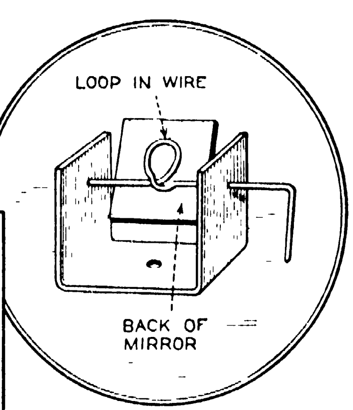
A MICROSCOPE magnifying from 25 to 300 diameters may easily be constructed in the home workshop, with practically no expense. Only the simplest and most ordinary tools are required.

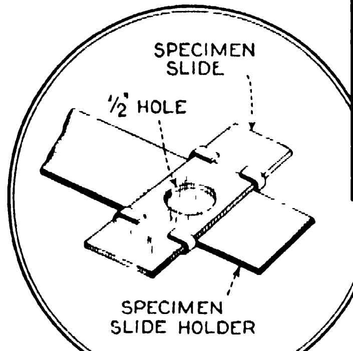
This may sound too good to be true, yet it is a fact. The reason is that small drops of water, which cost nothing, are used instead of expensive powerful glass lenses. A cylindrical diaphragm is also employed, doing away with blurring of the image and confusing rainbow fringes. The image thus produced is needle-sharp and absolutely free from objectionable coloring.

The upright at the right supports the lens turret. This is a thin brass or tin disk mounted with a screw and a washer. About half way from center to edge, a series of holes is drilled as neatly as possible and at equal distances from the center. The larger holes may be countersunk with a coarse needle, while the smaller ones are best left in their original condition. Burrs may be removed with very fine sandpaper. Extremely small holes are made as follows: Use the smallest drill you have and stop drilling when the tool is almost through—when a little "pimple" appears on the other side. Remove the drill, pierce the "pimple" with a fine needle and even up the edges with sandpaper.



The unessential details may be modified to suit the materials available. The cylindrical diaphragm is adjusted simply by bending its supporting wires





The wonder-working cylindrical diaphragm is held in place under the lens turret with three wire supporters. It is merely a small metal or cardboard tube closed on both ends with black cardboard disks and India-inked on the inside. A small hole is made in the bottom disk, while the top one or lid is pierced in the center with a fine needle heated to red heat in a flame, so it will not leave any burr.

A special holder for slips of glass upon which objects to be examined are mounted, is fashioned from a strip of thick tin. Its business end is shown in the left-hand drawing. The other end is securely nailed to the square beam. The holder is slightly bent in the middle, to accommodate a small roll of cardboard secured with glue or a thread and wound loosely enough to slide back and forth easily.

The square beam is drilled exactly in the middle and is held by a bolt and a nut, in a fork sawed out of the thick upright at the left. Washers should be inserted both inside and out, and the nut should be adjusted so that the beam tips readily and smoothly when a slight pressure is applied to the opposite end.

The U-like support of the mirror is fashioned from a single strip of tin and is screwed to the baseboard in the center to enable the microscopist to work comfortably, no matter from which direction the light falls. Liquid glue is used to attach the mirror to its looped-wire support.

No dimensions are given on the drawing, for the very excellent reason that they are of absolutely no importance. There is only one thing to watch for, when assembling the device. The fine pencil of light streaming up from the diaphragm should go squarely through the lens holes in the disk.

There is nothing difficult in the use of the water microscope. Decide which enlargement you need and choose a hole in the lens turret accordingly. The smaller the hole, the more powerful the lens. Rub the hole with your fingers, coating its sides with a thin film of grease, to prevent water from spreading. Dip a sharpened match into clear water and apply the point to the hole. Water retained on the match will flow down and form a nice round drop. Turn the lens turret until light from the diaphragm shows through. Work the mirror about to obtain the best lighting. When high powers are used, say 250 diameters, the source of light must be a strong one, preferably the sun or a powerful electric lamp.

Now insert the specimen slide in the holder, and focus roughly by tipping the horizontal beam. Fine focusing is done by sliding the cardboard roll. Keep the eye as near the water as possible.

If you prefer, glycerine may be used for lenses instead of water. Glycerine does not evaporate and you will not have to re-focus every little while, as with water. Perhaps you may even care to have a microscope with absolutely rigid lenses. Canada balsam, which may be obtained at any optician's, will harden in a week or so, if it is run into the lens holes and the microscope left standing in a warm dry place.

¶ Editor's note: *William Waldeyer, a San Francisco reader of this journal, has made an interesting suggestion. "Let the mechanically inclined amateur expend, say, eight dollars for a 10x objective, mount it in a stand of his own design, and add a 5x or 10x Huygenian eyepiece, also a small lens of short focal length for a condenser. Just as in amateur telescope making a little study will be necessary, but the first qualification for a real hobby is that something must be left to the ingenuity of the amateur." For the study, Gage, "The Microscope" is recommended. No blueprints or instructions are available.*

Work and Fatigue

Industrial Fatigue Is Passing Out of Style

By DONALD A. LAIRD, Ph.D., Sci.D.
Director, Colgate Psychological Laboratory

MEN of science visiting an exhibit arranged by the Genetics Department of the Carnegie Institution, saw a specially developed race of tireless mice which danced all day long. This was a product of careful breeding. Sir Arthur Keith and Ales Hrdlicka, well-known anthropologists of England and America, see evidence that a new type of man is emerging from the biological melting pot in America. Greater resistance to ordinary fatigue may be one of the characteristics of this new biological development in the human race, but none of us, obviously, shall live long enough to see this changed specimen. And it will not help to make us at present more resistant to fatigue.

Fatigue will doubtless be removed pretty thoroughly from the world many decades before the new biological man has emerged. In fact, one who has been keeping in close touch with the progress of fatigue elimination in industry for the last ten years knows definitely that a great deal of fatigue has already been eliminated.

IT is not the invention of labor-saving machinery that is doing most to eliminate fatigue. Such machinery may save the labor of three men, but add to the fatigue of the two men who operate it. The noise and jar and "high speed" attention the new machine demands is often more fatiguing than the brute labor that it is replacing. An invention can be labor saving but fatigue increasing.

Realizing this truism, some years ago the Society of Industrial Engineers organized a special Committee on the Elimination of Unnecessary Fatigue. This committee, to which I have the honor of belonging, serves to stimulate and co-ordinate the work on the conquest of fatigue in America. It has brought together mechanical engineers, physicists, physiologists, and psychologists on a common battle-ground for applying their sciences. In England we find a more formidable and official organization for battling fatigue, in the form of the Industrial Fatigue Research Board, which is a part of His Majesty's Governmental agencies. This board keeps a large group of investigators active in the textile, metal, wood-working, and other industries, searching out new facts about fatigue and new ways of eliminating it.

There are four general sources of fatigue which, fortunately, are being attacked by modern Saint Georges. The most treacherous and insidious source is poor emotional adjustment of the individual. One who is of necessity engaged in work which he does not like, or for which he is otherwise poorly adapted, is especially likely to experience a vague but pernicious fatigue. The rapid growth of vocational guidance in the schools, and the development of psychological tests for determining fairly accurately what work one can do best, are powerful forces for eliminating much emotionally generated fatigue. Monotony is another cause of emotional fatigue. We know that there is no such thing as intrinsically monotonous work; work which is monotonous to one person is fascinatingly interesting to another, but it is highly important that each individual work at a job which is not monotonous to him.

Fatigue of an emotional origin also arises from poor supervision of workers. The roughness of the foreman of the old school caused much fatigue. Today foremen and other supervisors are being given special training in how to handle people. This foremanship training, which is on a state-wide basis in states such as New York, is already eliminating much fatigue which has been caused by reprimanding and ill-chosen supervision of the kind not based on a good comprehension of the nature of human nature.

HUNDREDS of thousands of persons are suffering from fatigue of emotional origin, which however, has no relation to their daily tasks. These are persons with a poor emotional adjustment to life in general. They are persons who "enjoy being tired," just as about the same number "enjoy poor health." These thousands who awaken feeling tired after eight to ten hours of sleep need a general probing of their inner emotional lives. Psychiatrists and mental specialists are undertaking this on a grand scale throughout the country, largely as a result of the work of the National Committee for Mental Hygiene. Specialists have been trained for this work, and wholesale clinics

Courtesy of Harrington and King (Chicago)

A ceiling designed to absorb noise; adequate artificial lighting; restful wall colors; and venetian shades, free this office from environmental fatigue

have been established in a dozen large cities. Some larger firms have their own specialists who are engaged full time in guiding their workers to emotional readjustments which have not been caused by their work, but which are nevertheless a fatigue handicap.

The following typical case of this type of fatigue has been reported by Dr. V. V. Anderson who is engaged in this work with R. H. Macy and Company in New York. This case may be taken as illustrative not only of the pernicious hidden emotional causes of fatigue, but also of the highly socialized "long view" many employers are now taking of the problems of fatigue elimination.

Mary T. was a successful sales clerk, 35 years old. For half a dozen years she had been complaining of being tired and needing a rest. From time to time she had been given short leave from work with pay, and finally took six months with pay. The family doctor reported that she "must have a complete rest."

UPON Mary's return to work the store psychiatrist gave her state of chronic fatigue skilled study and found that "she acts very tired, seems exhausted, sits down a lot, leans against the counter, and seems to be a changed girl from what she used to be." Emotional causes for her chronic fatigued state were readily found. She has made but few friends, never goes out, and her only pleasures seem to center in the home of her father and mother, although her father complains a great deal about her not getting married. She is very jealous of her married sister and frequently has trouble at home with her father. When these unpleasant situations develop she indulges in a temper tantrum or appears to become ill, and thus obtains great sympathy from her mother and sister. Her "tired feelings" are another way of gaining sympathy and attention.

The psychiatrist explained her situation to her frankly, planned a scheme of emotional re-education for her, including social and recreational activities to keep her away from home, and arranged for her to have half-time employment. She needed to understand how she had been seeking pity and sympathy through appearing tired, whereas healthy emotions demanded the equivalent outlet through accomplishments and service to others.

Studying less fatiguing methods of work by means of the moving-picture camera set up in a manufactory

Her entire emotional attitude toward herself, her job, her home, and life in general was altered. Her mental health improved vastly and her chronic fatigue disappeared. She is now working full time and topping her department.

According to Dr. Anderson such cases are very common, and develop easily in almost anyone. They are neither normal nor abnormal, but in the broad borderline zone.

A second important general cause of fatigue is the physical condition of the individual. The phenomenal strides now being made in general hygiene and public medicine are accomplishing near-wonders, an example being the elimination of much of the pathological fatigue caused formerly by the hook-worm in vast areas in the southern states. The growing use of routine medical inspections of employes by company physicians is also accomplishing a great deal toward avoiding fatigue which is caused by some organic trouble rather than by the work itself. Some concerns, like the Dennison Manufacturing Company, have their executives undergo complete medical examinations semi-annually.

The activity of the ductless, or endocrine, glands appears to have a profound relationship to one's fatigue, although there is no definite single glandular mixture which is a cure-all for tiredness. This is a field both of great promise and great obscurity.

One of the most interesting aspects of the relation between bodily conditions and fatigue is the chemistry of the fatigue changes brought about by work itself. As physical work is done glycogen is consumed by the muscles, with the production of lactic acid and carbon dioxide as residual by-products. The carbon dioxide liberated is gradually breathed off, although in the case of excessively severe work some excess carbon dioxide may be stored in the adjacent tissues to be breathed away during less active moments. Lactic acid appears to be the definite cause, however, of actual fatigue caused by work. In almost every variety of steady work the lactic acid is produced more rapidly than it can be removed, bringing about a definitely toxic condition. This condition may spread to remote parts of the body. Heavy work with the right arm, for example, can readily produce an excess of lactic acid which spreads to the left arm. Working with one arm may thus tire the other arm; we also can recover from some of the fatigue of the right arm by the action of blood oxygen on the lactic acid in the left arm.

No chemical has yet been discovered which will offset these accumulations in the working body. During the World War, however, German troops were given sodium biophosphate before long marches, on the theory that this would offset the lactic acid formations.

IT is a fact that soldiers given this substance were usually fatigue-resistant, but more recent experiments have shown that the biophosphates did not produce this result by causing the lactic acid to disappear. It does help eliminate fatigue, but just how it works still is a question.

Since the body itself will attempt valiantly to remove the lactid acid, much excess fatigue has been avoided in industry by the introduction of rest periods so that the chemical factories of the body can remove much of the acid before there is such an excess that there will be the possibility of a serious fatigued state. Girls folding handkerchiefs, for instance, are least fatigued when they fold for five minutes and rest one minute. In heavier work, such as carrying pigs of iron weighing 92 pounds each, fatigue is least when each 12 minutes of work is followed by three minutes of rest. It is a paradox of mankind that by resting at the proper times they can do more work with less fatigue.

Some day a substance may be discovered which will take care of the lactic acid accumulation and take the place of rest periods. At present industry knows no such substance, hence each month sees a few thousand more workers being forced by their employers to rest during working hours.

Another paradox which is a result of the accumulation of lactic acid is that the longer workers are at work the less they accomplish. Workers who have been engaged in work eight hours a day, for example, when put on overtime which requires ten hours work a day, will do less after two weeks in the ten hours than they formerly did in the eight hours. The extra two hours work is doubly pernicious in adding to the total production of the acid, and subtracting from the rest hours during which the accummulation can be overcome.

With the shorter work week, as well as the shorter work day, large amounts of human fatigue will be eliminated—provided the worker knows how to use the added leisure time so that there will be no further accumulation of fatigue.

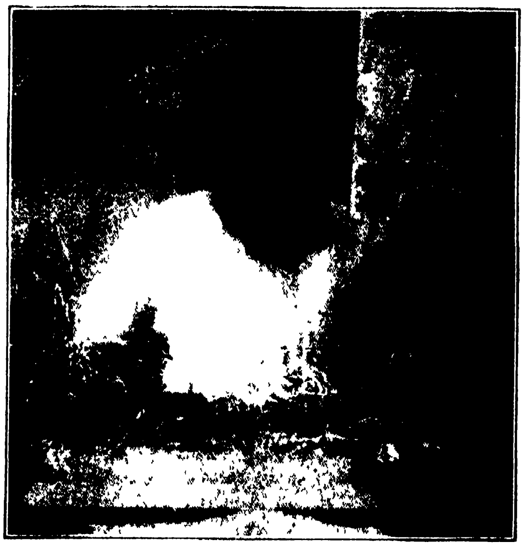
The third general direction from which fatigue is being attacked is by adjusting the environment so that less indirect fatigue is caused. The poorly lighted factory and home of a decade or two ago were the cause of much indirect fatigue—not only eye fatigue, but muscular fatigue due to the increased tension of the muscles in giving attention. Muscular tension is a form of work which consumes glycogen and produces carbon dioxide and lactic acid, even though no productive work is accomplished. With the invention of the incandescent bulb half a century ago Edison paved the wav for the elimination of much unnecessary and indirect fatigue.

IN the past decade a great deal has been accomplished by applying scientific knowledge concerning the relationship between temperature and fatigue. When the temperature goes above 68 degrees, Fahrenheit, fatigue is abnormally increased, unless the cooling power of the air is increased by being set in motion. Thermostats and chemical refrigeration are now being widely used, not merely in those industries which are intrinsically heat-producing, but in offices as well.

Within the past year or two another cause of indirect fatigue has been stalked out into the open—noise. I am naturally proud of the part the Colgate psychological laboratory has had in discovering minimum allowable noise analogous to the optimum temperature of 68 degrees, Fahrenheit. Scarcely a new office or factory is designed now without noise control being given thoughtful consideration, and many old work places are being remodeled so that they approach the minimum allowable noise of 35 decibel units.

The three general causes of fatigue—poor emotional adjustment, bodily condition, and environmental forces—have been discovered and worked out, largely by men of science outside of industry. The fourth general cause has been attacked largely from within industry itself.

This fourth general cause is fatiguing methods of work. Research on this source of loss received its impetus in the United States three decades ago. For the following 20 years the investigation was kept up, largely to gain increased output rather than directly to reduce fatigue. The last decade however, has witnessed a shift in the approach, because it has been demonstrated thoroughly that the greatest output is achieved when the methods of working are least fatiguing. So, in place of trying directly to reach greater output per worker, the approach now is to reduce all possible fatigue in methods of working. Thus the output will take care of itself better than it would if one tried directly to improve the output factor alone. The aim should be to make the work as easy as possible; very greatly in contrast to the primary aim of the "efficiency expert" with his pockets full of colored pencils, who, thank goodness, is going out of fashion along with fatigue. I believe in general that England is more awake to this changed approach than is America.



Time exposure record of movements of the hands of a worker. When given expert study this picture will reveal waste effort

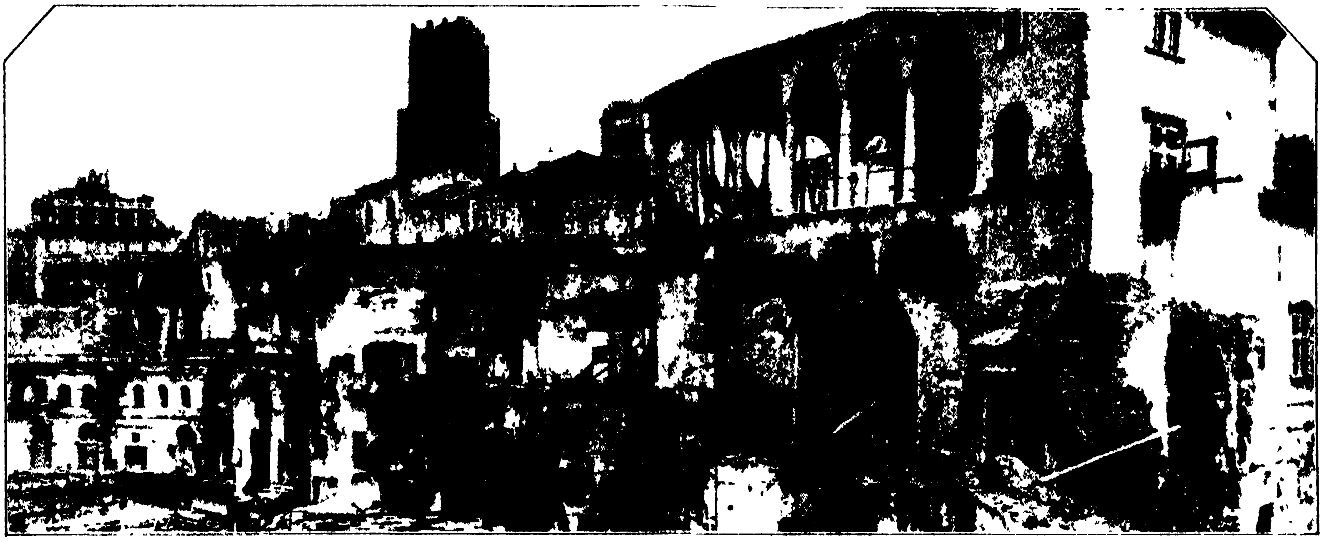
So much of the work that has been done to make working intrinsically easier is so simple and so obvious that it reflects little credit to the human mind that this has not been done years ago. Take, for example, the small metal stand on which hot irons are placed in the laundry. These metal stands are necessary to keep the cloth covering of the ironing board from being scorched while the goods to be ironed is being smoothed out. It has not been unusual for these metal stands to be six inches in height. Lifting a five-pound iron to this height an average of 60 times an hour constitutes 150 foot-pounds of work, and since the human body has an efficiency only of about 20 percent, this means the consumption of bodily energy equivalent to 750 foot-pounds. Today iron racks scarcely an inch high and sloping gently toward the point are in use, so that the iron does not even have to be lifted but is simply slid on to the rack.

In tin-plate and sheet-steel manufacture human effort is being diminished, more perhaps in American than in English mills. In feeding the heavy bars or plates to the rollers which flatten them gradually into sheet form English workers have to lift them from two to three feet. The rolls are conventionally several inches lower in American mills, and thousands of horsepower of human energy are saved daily through this difference of a few inches. An inclined runway with freely idling rollers is now being adopted to bring the sheets or bars all the way to the powered rollers by sliding the plate along rather than lifting it. Thus more fatigue and sore arms are eliminated. Similar application has been made in hand-stoked furnaces, where coal-hole doors are no longer four feet above the floor level.

LIFTING, stretching, bending, stooping, sitting all day, standing all day, produce fatigue rather than effective work, and they are being eliminated with amazing rapidity in modern industry. Special departments are being established in large work-places to train new workers how to work most effectively with least waste fatigue. All these pay both financial and human dividends.

Intensive experimentation since this article was first written is now indicating definitely that a diet rich in carbohydrates and especially quick-energy sugar of the common table variety will lessen the fatigue loss which ordinarily comes from the depletion of glycogen and the accumulation of lactic acid. These experiments at Colgate University and at Temple University have shown that less fatigue is experienced when this preparation is made for exertion.

One does not have to be a carping critic to notice that the general pace of life is getting more severe during man's leisure, but one does not have to be a blind optimist to discover that the work of the world is rapidly becoming less fatiguing. Whether the diminished human strain incidental to the work of the world will compensate for the increased human strain during man's idle moments, is a question I can not answer, but is a question of grave significance.



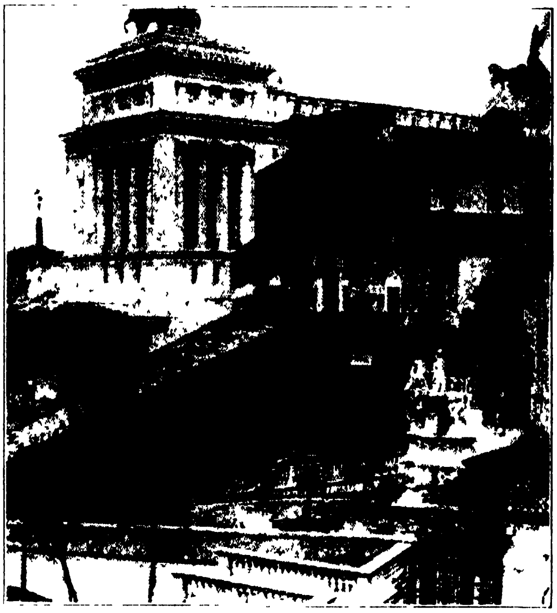
The Rome of the Caesars reappears in the modern Rome of Mussolini: The Fora of Augustus and Trajan

Rome's Slums Reveal Imperial Ruins

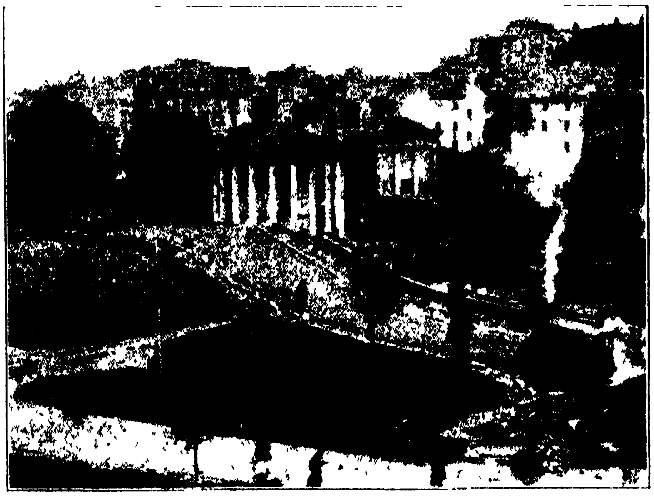
WHATEVER the Fascist government may have done or left undone, one great accomplishment stands to the credit of the great leader "Il Duce." This is the carrying on of excavations on an unprecedented scale. Excavation in a crowded city like Rome under post-war conditions presents grave problems. Where the density of population is very great, the slums can not be destroyed until the people are housed. When the ruins are uncovered they are made available to the scholars of the world, and wherever possible they are given a landscape setting.

In Italy cultural matters are receiving their due. While other countries have allowed important buildings to be sacrificed for utilitarian purposes, Italy has always looked askance at the tempter and resisted, which is hard when it is necessary to contend with national poverty.

Our illustrations show how the beauty of the ancient structures has been revealed after demolition of ugly modern buildings. The Fora of Augustus and Trajan, which for centuries have been covered by later buildings, are now emerging in a remarkable state of preservation. The tower shown in the photograph above is the so-called "Tower of Nero" from which he observed the burning of Rome. Unfortunately for the story it was built in 1200 A.D. Adjacent, a great covered market with 150 shops in the Oriental style has been discovered. The "Theater of Marcellus" has been laid bare down to the foundations. The temples of Vesta and the Vestal Virgins have been freed from buildings.



A new vista opened in modern Rome, displaying the Victor Emmanuel monument towering above the Aracoeli church after demolitions



The Temples of Vesta and the Vestal Virgins now entirely cleared of old obstructions of later buildings

The Theater of Marcellus reappearing after being concealed for centuries by squalid structures now removed

The Imperious Sycamore

By WILLIAM
ALPHONSO MURRILL

> "Clear are the depths where the eddies play,
> And the dimples deepen and hurl away;
> And the plane tree's speckled arms o'ershoot
> The swifter current that mines its root."
>
> *Bryant*

WHO has not at some time rested serenely in the shade of a big sycamore tree with scaly, white trunk and wide-spreading branches? I well remember one of these giant trees that stood alone in a fertile meadow, with a cool spring nearby and cultivated fields all about it. At noon the men would come with their horses and wagons—there was room for all and to spare—and eat their dinners while the horses finished their oats or corn and chewed contentedly at wisps of grass.

At wheat harvest and threshing time, the women-folk would meet the men at the tree and spread good things from big baskets on tablecloths laid upon the grass. Appetites sharpened by hard work would take on a razor edge at the sight, and soon a few of the older men would be taking little cat-naps while their stomachs wrestled with unusual responbilities.

THEN the "boss" would get up and squint at the sun, or peep at his big silver watch, and say, "Well, men, I reckon we've rested long enough; let's get busy."

With this scene in mind, it is not difficult for me to imagine the religious ceremonies held beneath the oriental sycamore on the plains of Persia, when splendid rugs were spread upon the ground, the roots of the tree wet with libations of fine wine, and the branches bedecked with jewels and gold. It is said that Xerxes halted his army for days just to behold a single tree of this species, which was so imperious and shapely that he had its form stamped upon a medal in order to have it before him the rest of his life.

The Greeks also venerated this noble tree and planted it in groves and about their dwellings. The botanical name *Platanus* is derived from the classic Greek name, which refers to the broad leaves. In Europe, it is known as the plane tree, while the name sycamore is always applied to a maple with leaves resembling those of the plane. In still earlier times, the name sycamore was applied to a fig tree, the wood of which was used for mummy cases. The tree which Zaccheus climbed for a better view was Pharaoh's fig, *Ficus Sykomorus*, a native of northeastern Africa. Fig, maple, plane—all sycamore; but in America it is still sycamore, in spite of the wise ones.

The American sycamore, or western plane, is the largest hardwood tree in North America, sometimes reaching a height of 170 feet and a trunk diameter of 11 feet. A specimen at Sunderland, Massachusetts, measured 22 feet in circumference and over 100 feet in height when it was three hundred years old.

A sycamore of the Wyandotte Indians, at Sandusky, Ohio, was once the largest tree between the Alleghanies and the Rockies, four acres of ground being shaded by its immense top. After the Indians ceased their pow-wows, it became a favorite place for picnics, and then a group of young men made it a Sunday rendezvous for drinking and card-playing. The owner appealed to them to quit the place but they refused, so he burned the tree. Unfortunately, its age was never computed, but its trunk was fully 11 feet or more in diameter.

Specimens of the oriental plane have been known to have lived 4000 years. On the Greek island of Cos there is one so old and ponderous that its branches had to be supported with marble columns. It stands in a public square

In low, rich land, the sycamore thrives and makes a beautiful shade tree such as the one shown in the meadow at the left. Below at left are shown bark, fruit, and leaves of the western plane or American sycamore. Below at right, of the London plane tree

and is held in great veneration by the inhabitants.

Our American sycamore tree occurs wild from Ontario to Florida and westward to Minnesota and Texas, preferring open meadow land or low woods. The bark is very characteristic. On the young trunk it is smooth and greenish gray. The outer bark flakes off annually in large patches, exposing the white under bark. Near the base of old trees, the bark becomes thick, deeply furrowed, and dark brown. The trunk appears at times like an old warrior covered with battle scars.

The large, simple, somewhat star-shaped leaves are sometimes seven inches broad; and the fruit is a ball an inch in diameter hanging by a slender stem during the winter and breaking up in the spring, when the small seeds are widely scattered by the wind.

THE wood is rather strong but decays rapidly in contact with the ground. It is used for butchers' blocks, tobacco boxes, furniture, interior finish, crates, tools, and rollers. The reddish-brown color is attractive, but the logs are "mighty hard to split."

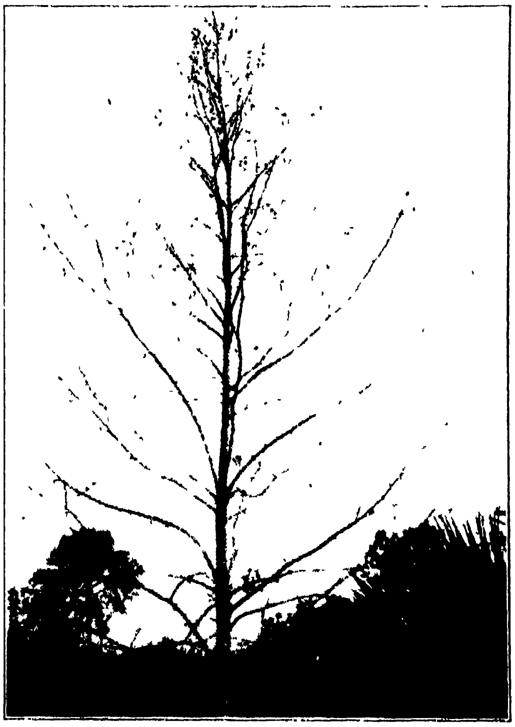
The plane trees form a family all by themselves with only eight species, natives of the north temperate zone. We have one native species in the eastern United States while there are two others in the west and three in Mexico.

At right: **peeling bark of the American sycamore. The bark that is exposed is a creamy white**

The oriental plane was brought to Europe by the Romans from its home in southern Asia and has been abundantly planted as a shade tree in cities. A hybrid between it and our western plane, known as the London plane, is the most abundant and thrifty tree on the London streets and is very popular in this country. Our tree was introduced into England early in the 1600's and at one time the French were quite fond of it.

The sycamores, or plane trees, are all more valuable for shade and ornament than for lumber. They rank next to the oaks as street-trees, and are preferred by many. With the annual scaling of the bark, the tree rids itself of the smoke and dust of cities. The branches may be cut back as often and as freely as desired without permanent injury to the tree. The sycamore blight disfigures our tree in the spring, as well as the London plane, but the leaves come out again in time to keep off the hot summer sun.

In Paris, at least one third of all the street trees are planes. With plenty of good soil and water, these trees keep vigorous in spite of the severe conditions of city life. They are large enough for wide avenues, and they can be cut to fit the narrow streets on which they are often planted.



The American sycamore in winter presents an appearance of sleekness and fruitfulnes

Either the American sycamore or the London plane makes a sturdy street tree. Often they are trimmed and shaped somewhat in the manner of hedges

For the benefit of those who find it difficult to distinguish between our native western plane and the London plane— which is still called the oriental plane by most of our nurserymen— I would say that the two trees differ in their bark, leaves, and fruits, as well as in their general form; but a glance at the bark and fruits of any doubtful tree will at once decide the question. When the London plane sheds its bark, the patches beneath are pale greenish, instead of white as in our species. The fruits of the western plane are usually borne singly, while those of the London plane are in clusters of two to four, with the balls often arranged one above another.

THE long, tapering single seeds are tightly compacted within these balls, radiating out from a hard core. The minute flowers are borne in pendulous heads containing either male or female flowers.

The leaves of the oriental plane are five-lobed, hairless, of a bright green color, and are arranged alternately on the twigs. The leaves of the London plane are usually three-lobed. The western plane the American sycamore which is also sometimes called the buttonwood has leaves that are more leathery and less deeply lobed than the oriental plane. Other common varieties under cultivation are the maple-leaved plane and the *variegata*, which has variegated foliage.

Typical of South Carolina's produce farms. Snap beans on a farm near Charleston

Vegetables That Defeat Goiter

By M. BISHOP ALEXANDER

> **GOITER is an abnormal condition of the thyroid gland caused by iodine deficiency. And since the substances secreted by the thyroid govern the growth of all cells, promote metabolism, and perform many other useful functions in the body, it is vitally important to maintain this gland in healthy condition**
>
> **In an article in our April, 1926, issue, Dr. J. W. Turrentine pointed out that America is a goitrous nation and urged the use in foods of marine algae as a preventative and cure. The present article is, therefore, a fitting follow-up, and especially since it indicates a more palatable food cure.—*The Editor.***

"IODINE." This word stands out prominently on the labels attached to shipments of fresh and canned vegetables from the state of South Carolina to all parts of the nation. We are frankly puzzled. What does it mean? Why iodine? The answer is found in the wording on the label. We scan it closely and find thereon the statement that:

"South Carolina fruits, vegetables, and milk naturally contain sufficient iodine to provide for the requirements of nutrition."

The explanation of the answer and its importance is readily seen in the authoritative statement from scientific and medical sources that all animals require certain amounts of iodine to prevent goiter. The importance of the discovery and announcement that South Carolina grown products contain iodine, which in proper quantities is a goiter preventative and cure, is further indicated by the following official statement:

"THERE are 30 million persons in the United States who have an iodine deficiency and two thirds of the states are in the iodine deficiency area."

Dr. Weston, a prominent physician and baby specialist of Columbia, is credited with discovering and calling attention to the mineral value of South Carolina grown products. Observing in his practice that goiter was exceedingly rare in South Carolina and being familiar with the work of American and European investigators on the relationship of iodine to this malady, he conceived the idea early in 1923 that the foods grown and consumed in South Carolina must be responsible for the very low percentage of goiter in that state. He discussed this idea with several of his friends and finally prevailed on the General Assembly of the state to provide for a commission to study the mineral elements in foods grown or produced in the state. Thus came into being the South Carolina Food Research Commission.

This commission consists of Dr. D. M. Douglas, President of the University of South Carolina, Dr. E. W. Sikes, President of Clemson College, Dr. Robert Wilson, Dean of the Medical College of the State of South Carolina, Dr. J. A. Hayne, Secretary of the State Board of Health, and two others: Dr. Weston, who acts as chairman, and Dr. R. R. Walker, Secretary, appointed by the Governor.

The South Carolina Food Research Commission established its laboratory in affiliation with the State Medical College at Charleston and under direction of Dr. Roe E. Remington, who was called from the University of Minnesota to take charge of this important work.

During 1928 and 1929, Dr. Remington examined in the laboratory at Charleston hundreds upon hundreds of samples of vegetables grown in all sections of South Carolina, for their iodine content. He found the amounts of iodine in them enormously greater than those reported by other laboratory workers in vegetables from northern, western, and, in fact, any other states.

THIS discovery in conjunction with the goiter survey made by the Field Force of the South Carolina State Board of Health, in which it was found that goiter was practically non-existent in the state, led to the definite conclusion that goiter will not occur if foods that naturally contain a sufficient amount of iodine are regularly eaten.

The results of the analyses of South Carolina foods for iodine content were broadly summarized by Dr. Mazyck P. Ravenel, in the *American Journal of*

Public Health, September, 1929, issue, as follows:

"While similar data (analyses) for the entire country are not available for comparison, it can be said that the vegetables grown in South Carolina contain from 20 to 30 times as much iodine as those produced in . . . . and . . . [two great vegetable-growing states—*The Editor.*] * * * * * It has already been pointed out that the vegetables which are richest in iodine are also richest in vitamins and iron."

The amount of iodine necessary in the daily ration in order to maintain iodine balance is variously estimated. The only careful experiment is that of Dr. von Fellenberg, of Switzerland, who was able to maintain iodine equilibrium over a period of four weeks in a man on a diet which contained 0.0143 milligrams per day (equivalent to 5.22 milligrams per year).

DR. REMINGTON has calculated the weight in ounces of some fresh vegetables from South Carolina which will yield this amount of iodine.

LEAFY VEGETABLES	
Cabbage, average of 8 samples	7 ounces
Lettuce average of 9 samples	8 ounces
Spinach, average of 14 samples	7 ounces
Turnip tops, average of 5 samples	10 ounces
POTATOES	
Potatoes, average of 76 samples	11 ounces
Sweet potatoes, average of 70 samples	16 ounces
ROOTS	
Beets, average of 4 samples	24 ounces
Carrots, average of 8 samples	21 ounces
Turnips, average of 12 samples	23 ounces
Asparagus, average of 22 samples	27 ounces

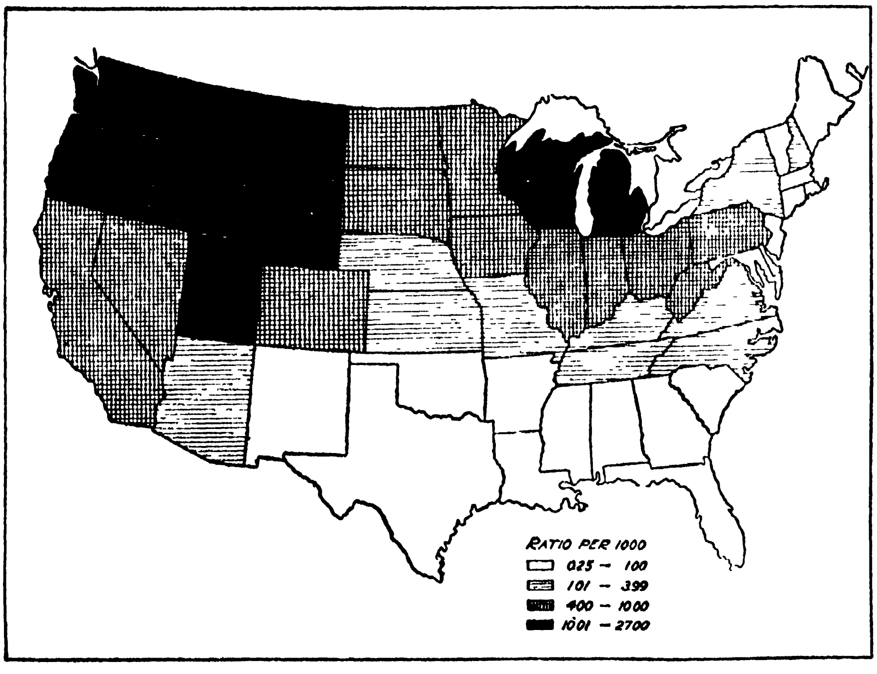
On this basis, a diet containing four ounces of green vegetable, eight ounces of potatoes, and four ounces of root vegetable would yield 0.021 milligrams of iodine per day which is about 150 percent of the value set by von Fellenberg. Since this quantity can be, and frequently is, eaten at a single meal, it is felt that these vegetables are adequate for goiter prevention when eaten regularly.

"A sufficient amount of iodine in the food supply," Dr. Weston says, "is essential to the well-being of every individual, and if deficient there results enlargement of the thyroid gland in the neck, lowering of mental and physical ability, and ofttimes sterility.

"We have learned that some foods are more valuable than others in regard to their content of chemical elements. Among the best are lettuce, spinach, cabbage, carrots, beet tops, turnip tops, kale, and broccoli." He said also that "modern methods of canning do not seriously impair, if at all, the chemical elements of fruits and vegetables."

Dr. Roe E. Remington, who directs the food research at the laboratory in Charleston

Figures compiled by the United States Public Health Service show that the goiter incidence is high and is a serious problem in large sections of California, Connecticut, Colorado, Kentucky, Illinois, Indiana, Idaho, Kansas, Louisiana, Minnesota, Michigan, Massachusetts, Missouri, Montana, Maine, New York, Oregon, Pennsylvania, Utah, Virginia, West Virginia, Washington, and Wyoming. The northwest has a high incidence.



Ratio of simple goiter found in men examined for service during the World War, based on 2,510,701 examinations. From U. S. Public Health reports

From an historical standpoint, goiter is one of the most ancient and interesting diseases. It was a health problem in China 15 centuries before Christ, and it was then a custom among the Chinese to feed thyroid substances from animals and the ash from burnt sponges and other materials, now known to contain iodine, in the treatment of goiter.

Iodine first was discovered in 1811 by Courtois, a saltpeter manufacturer of Paris, and its first deliberate use as an element in the treatment of goiter was by Coindet, a physician of Geneva, in 1820. Thirty-two years later, Chatin directed attention to the fact that goiter was more prevalent in regions where soil and water were low in iodine content. Between 1922 and 1927, Dr. J. F. McClendon, Professor of Physiological Chemistry in the University of Minnesota, published a series of articles which were largely responsible for definitely crystallizing the relation between a deficiency of iodine in the food supply and the incidence of goiter.

THE South Carolina Food Research Laboratory was made ready in 1928 and after a number of analyses had been made it was decided to seek expert advice as to checking the equipment, methods, and laboratory results. In a conference in Chicago between Morris Fishbein, M. D., editor of the *Journal of the American Medical Association* and a Contributing Editor of the SCIENTIFIC AMERICAN, Dr. Clifford Grulee of the University of Chicago, and Dr. Weston, all agreed that, because of his international reputation and high standing among chemists, Dr. McClendon was the man for the task. Negotiations were entered into with him and later he visited the laboratory. After carefully checking the apparatus, methods of analysis, and the results, he enthusiastically stated that he believed the solution to the serious goiter problem had been found. In 1929, he spent his summer vacation in the laboratory and again freely confirmed the results obtained there.

Since the endorsement of Dr. McClendon, the reports made by the laboratory under Dr. Remington have been accepted without question by the American Medical Association and the American Chemical Society. Dr. Mazyck P. Ravenel, Chairman of the editorial committee of the *American Journal of Public Health,* has also expressed the opinion that the laboratory has "found the solution of the gravest health problem confronting the people of the United States."

Inspecting hanks of artificial silk in a large American plant

Mechanical Silkworms

By GRACE LOCKHART

"WILL you walk into my parlor?" said the spider—and man walked in! Ever seeking new worlds to conquer, he carefully examined "the prettiest little parlor that ever he did spy." And then he walked out to compete with his spider-host.

Silk is a liquid substance secreted from their food by various insects, of different families, but principally by the spider and the silkworm family. The silk of the spider family is of most exquisite quality, and is the finest spun filament produced in nature. From time to time it has been used to make fragile silken articles. But the small amount of the product and the difficulty of controlling spiders have made its commercial use in large quantities impractical.

YEARS of patient experiment followed by many practical tests resulted recently in perfection in the scientific laboratories of the American Bemberg Corporation at Elizabethton, Tennessee, of the closest approximation yet made by man to spider filament.

The diameter of spider filament measures 0.00023 of an inch, the diameter of the man-made filament 0.0004 of an inch. An ordinary newspaper sheet is nine times the thickness of a single filament of the man-made product, and in a single pound there are 4227.5 miles of filament. Out of it are being woven the filmiest of laces, the sheerest of chiffons, exquisite fabrics for modern womankind—at once beautiful and enduring.

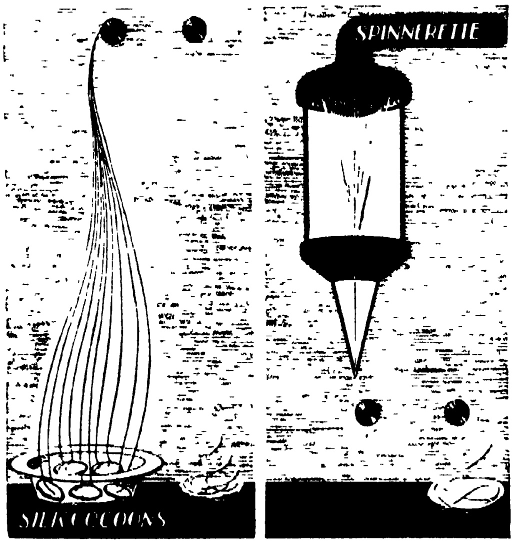
The size of yarn is designated by the term "denier," this yarn being 15 denier. The inventive mind, however, is seldom content to rest on the laurels of past achievements, and it is said that a 5-denier yarn was successfully spun in the Elizabethton laboratories to the astonishment even of the spinners themselves. It was so fine that those who watched could not see it. The hand could feel it, but the filament was invisible to the unaided eye.

THE basic raw material used in the manufacture of the yarn is cotton linters, that very unprepossessing gray fuzz that clings to the cotton seed after ginning. By a stretch-spinning cuprammonium process of manufacture, unnumbered tons of linters, formerly a waste product, are now being transformed into soft, shimmering multi-filament strands of Bemberg. So similar to silk thread, both in internal structure and external appearance is the produced yarn, that, woven into hosiery or into fabrics, experts cannot by sight or touch distinguish between the man-made fiber and the product of the silkworm.

Curiously, an order was recently received, the first of its kind recorded in history, for man-made spider webs. They were woven by hand with infinite patience in the laboratories of the American Bemberg Corporation and used for decorative purposes in "Old Algiers," first unit of a new chain of restaurants at Broadway and 102nd Street, by the well known restaurateur, William Childs. The interior reproduces an old Algerian village and in this very interesting manner modern scientific skill was called upon to heighten the illusion of antiquity by supplying artificial spider webs with which to decorate odd corners of the restaurant.

The cuprammonium process of manufacturing these ultra fine filaments was perfected after patient investigation of the interior of the silkworm and careful study of his spinning technique. The silkworm's product is made from the cellulose of mulberry leaves, the man-made fiber from cellulose of cotton linters. The dissolved cellulose of linters is drawn through tiny perforations in the mechanical "spinnerette" exactly as it is drawn through minute orifices called "spinnerettes" in the neck of the silkworm.

From the point of view of volume, however, the machine distinctly has



Similarity of natural silk and artificial silk: a number of fibers make one thread the advantage. One silkworm during its lifetime can produce from two to six filaments of silk thread about 1000 yards in length, whereas the machine produces 112 filaments at one time and in a thread that is endless. Cuprammonium yarn produced last year throughout the world would more than reach from the earth to the moon —a mean distance of 238,857 miles.

In the chemical process by which these miles of glistening filaments are produced, the linters are washed, bleached, and then dissolved in a solution of ammonium copper oxide. After being aged, the solution is filtered and pumped to the spinning machine. As it passes through the spinnerette into a fixing bath the surplus stretch is taken out of the filaments before they unify so that they emerge in a thread of unusual strength and pliability.

DUE to the minute accuracy of the machine, it has been possible to improve upon nature's product. Microscopic cross-sections of silk threads and threads made of Bemberg show an amazing similarity of structure, with greater uniformity of filament structure in the man-made fiber. Fiber and fabric have the same appearance, the "hand," texture and bloom, the scroop and crunch, and the subdued luster of pure silk.

Besides the cuprammonium method there are three other important processes of manufacture used today for making these yarns. They are known as the viscose, cellulose acetate, and nitro-cellulose processes. The resultant fibers and fabrics woven from them differ considerably from each other in characteristics and qualities. The volume output, known generally to the public as rayon, is made by the viscose process, sometimes of wood pulp, sometimes of linters. About 85 percent of the chemical yarns manufactured in the United States are made by this process.

The United States has invested more than 120 million dollars in plants for the manufacture of synthetic yarns, while the world investment is estimated to be one and a quarter billion dollars. The total world production last year was over 468 million pounds, of which the United States, both the largest producer and the largest consumer of chemical yarns, produced more than 100 million pounds. Less than half a century old, man-made yarns have been developed and perfected until today they rank in importance with the ages-old silks, cottons, woolens, and linens.

Looking backwards, we find, in the year 1734, an ingenious Frenchman named Bon making hosiery and gloves out of spider web; not, however, with spectacular success and not, certainly, for mass consumption. A century later one George Audemars of Lausanne, Switzerland, obtained a patent for transforming dissolved nitrocellulose into filaments which he called, descriptively, "artificial silk."

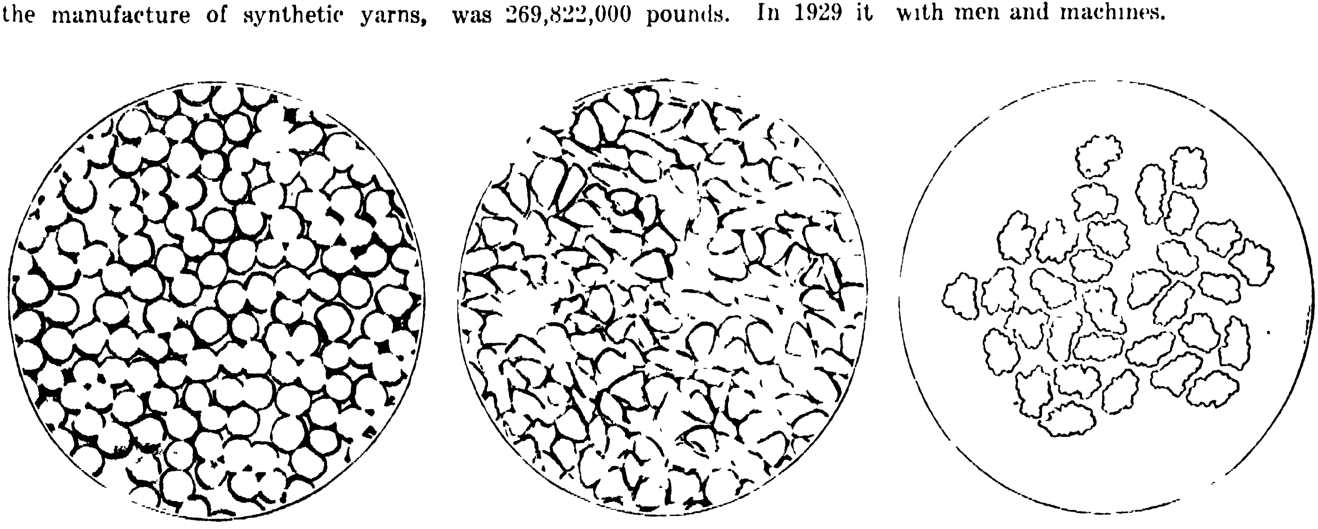
Efforts to produce this material, however, did not assume commercial importance until 1884, when Count Hilaire de Chardonnet, called the "father of the rayon industry," perfected a practicable process for manufacture. His achievements were viewed by the public for the first time at the great Paris Exposition of 1889, and excited much interest.

COMMERCIAL production of synthetic yarn was begun in Germany, in France, and in Great Britain at the opening of the 20th Century. Plants were established in Italy in 1908, in Holland in 1912, and in the United States in 1910. During the last five years constant experiment with resultant improvement in technique and the rapid development of new uses for chemical yarns has resulted in a spectacular increase in their production. In 1927 the world production was 269,822,000 pounds. In 1929 it had increased to 467,330,000 pounds.

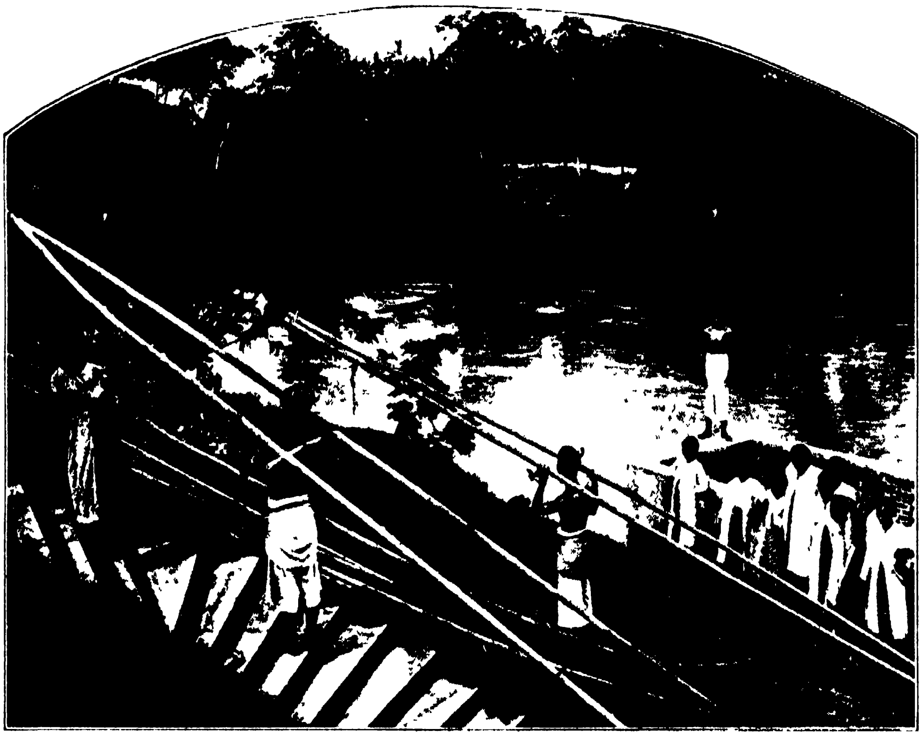
Spider web of man-made filament in the courtyard of a New York restaurant

The establishment of the American Bemberg Corporation plant in 1927 in Elizabethton, within two years time transformed a sleepy little village of 2400 inhabitants into a flourishing industrial town of 12,000. Thousands of mountain folk on foot, on mule, and on horseback followed in the wake of science. Thousands of men and women set themselves the task of feeding and tending the giant mechanical silkworks. Thousands who had watched the spider spin his silver web in the blue-green shadows of southern hills, engaged in the task of spinning, with steel fingers, the same infinitely fine filaments at the foot of Smoky Mountain.

The spider toils on, weaving nets to trap his prey. The industrial chemist also toils on, weaving silken garments for the Colonel's Lady and Judy O'Grady, displacing the old with the new, displacing spider and silkworm with men and machines.



Inspection under the microscope of the internal structure of natural and artificial silks shows the filament contours. At the left is Bemberg filament; in center, natural silk; and at right, viscose rayon—all magnified 300 times



Transporting bamboo to the market. Often it is floated down the river, then carried by the natives

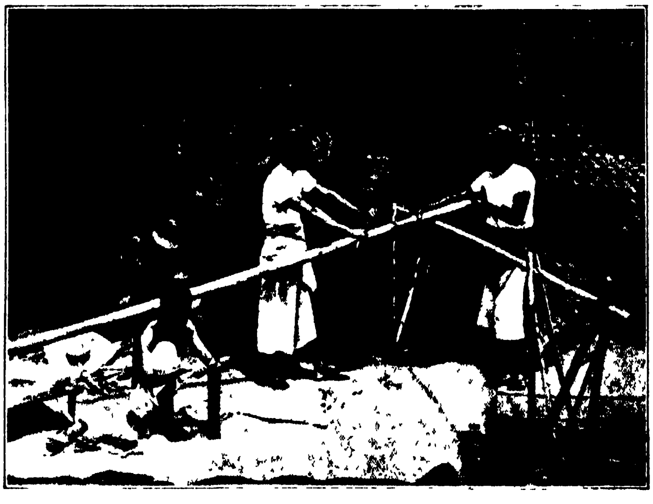
By HENDRIK de LEEUW

'Panama' Hats From the Pacific

THE American farmer who uses the old-fashioned floppy "straw" hat does not realize that he is perhaps indebted to the deftness of slim brown hands in the far off Dutch East Indies for the sunshade that protects him from the blistering sun. Likewise, milady of New York, London, or Paris may not be aware of the fact that her blocked, or basket-weave, or rough "straw" is from the same source. Hats of many different shades and colors, in almost countless models and shapes, and of a variety of materials 15 to 20 millions of them are made yearly in these distant islands for the markets of the world. The United States purchased over 8,000,000 of one kind in 1927.

The Dutch East Indies are richly endowed by nature with the materials of which these hats are made. Bamboo in many varieties is found in Java, Madura, Bali, and Lombok; rattan in the outer islands; pandanus in Sumatra; lontar palm in the eastern archipelago; and various grasses in many localities. Pandanus grass has long, strong leaves and is famous for its use in the Sumatra solid plaiting. Lontar leaves have long been used by the natives as writing paper, while in the Celebes and in Borneo, the natives have used *foeja*, or beaten bark, in their crude cloth and hat manufacture. In fact, the various fibers and growths of the jungle play an important role in the lives of the natives. The young roots of the sago palm and twigs of the liana serve as material for baskets, mats, and crude harvest hats; unopened leaves of a wild banana are used in making garments; and other fibers, leaves, and bamboo strips are fashioned into fishing nets, cages, ornaments, war garb, old-fashioned payongs (umbrellas), and so forth.

The hat industry, so the story goes,



Bamboo is harvested before the branches bud, cut into lengths of six or seven joints each, and then scraped

The natives cut the bamboo into blades and these are split again and again until divided into thin strips dates back to the 1850's when a Chinese migrated to the Dutch East Indies from the Philippines, at that time the center of the hat industry. He settled in Tangeran, in Java, about 14 miles from Batavia, and started in a small way the manufacture of so-called Panama hats. As the new industry showed signs of a lucrative future, a Frenchman named Petitjean took it up on a larger scale. Rivalry ensued and the competition stimulated the growth of the business until it had spread to all the islands.

THE hats originally produced were rather crude, but as the industry developed, more up-to-date methods were adopted although the greatest part of the work is still carried out in the homes of the natives. The whole family assists in the work, the men usually preparing the material while the women and children do the plaiting of hats. The men do the final stitching and ironing.

In making hats of bamboo strips, the bamboo stalks are cut before the branches bud and are carefully handled, since bruising causes red spots. Those that are floated down the river are used for inferior hats because they receive many injuries. And although bamboo is plentiful in the islands, most plaiters buy it in the markets.

In preparing bamboo for plaiting, the stalks are first cut into pieces six or seven joints long and the green rind is removed. These pieces are exposed to the sun and the dew of night to whiten them. The following day they are split into blades three or four inches wide. These, in turn, are split into laths about one inch wide and the splitting is continued until finally five to nine strips are obtained from one piece. After a further exposure to the sun and dew—to make the strips flexible—they are divided into "straws" by means of a wooden or a bone knife.

At this stage, a peculiar thing happens. The prepared bamboo "straws" are sent to Europe for bleaching by a jealously guarded secret process, and are then returned to the islands for plaiting.

The pandanus grass leaf is prepared for plaiting by removing the midrib, cutting the halves thus formed into strips, and removing the outer surface of the leaf. The strips are then boiled for a night, dried, and also sent on a trip to Europe for bleaching. The grayish fibrous leaves resemble raffia at first, but when finally ready for plaiting, they assume the creamy white color of the Panama hat.

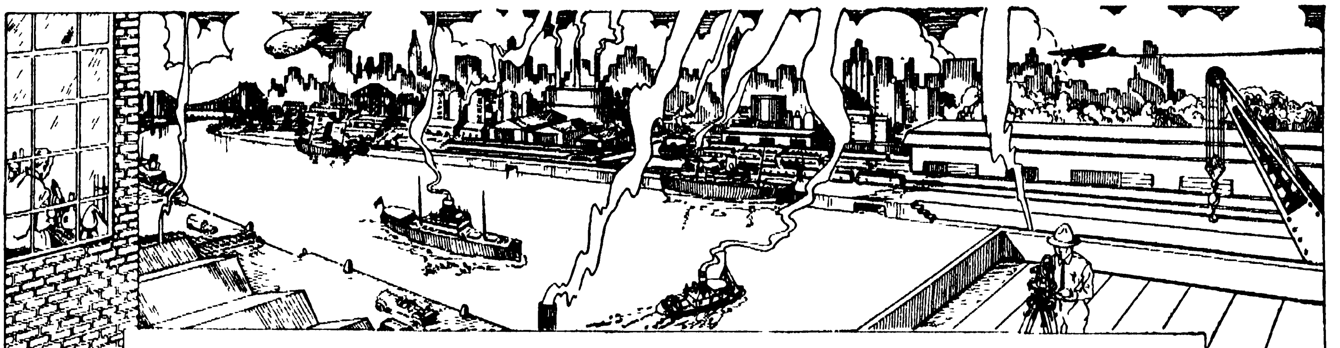
Further splitting. Prepared material, together with several finished and one unfinished hat

A hat of ordinary quality generally takes about two days to manufacture. One of higher quality may require four days or even longer. In plaiting them, the crown is begun first on a round board in which a flat-headed nail has been driven as the central starting point. Only the most experienced plaiters do the work on the apex of the crown. As the plaiting progresses, the hat is placed upside down on a board through which there is a hole large enough to receive the crown. The "barrel" of the crown is then plaited within this hole, which acts as a pattern or guide for the size. When this is finished, the brim is plaited flat or curled, as may be desired. Finally the hats are washed, air dried, and packed for shipment.

Besides going to countries of the western world, hats from the Dutch East Indies are sold to Australia for the fruit pickers in this case being one yard in diameter, to the Orient in fez shape, to Singapore for children, and to many other places in the form of topees, blocked, unblocked, bleached, or colored hats. Many of them are lined with inserted hats of coarser variety, the brims being woven together at the edge.

IN the Dutch East Indies, there are as many styles of home-made hats as there are tribes. One finds in some localities, hats with beaded borders, in others, hats beautifully embroidered with gold or other precious metals and used by native princes. Some of the Dajak tribes make plaited hats with intricate decorative patterns worked into them. Some of these are worn only by persons of high standing or are given the dead to take with them to "Apo Kasan," the Dajak hereafter. The *songko,* a flat, stiff, bamboo-plaited cap- also sometimes made of lontar fiber is the original headgear of the certain tribes of Celebes and is worn by grandees and officials. It is often elaborately embroidered with gold and silver braids. Select specimen's of the native hatter's art become heirlooms and are presented to married couples as prized gifts.

Native women doing the intricate work of plaiting, at which they are very proficient. Their hands move so fast that one can hardly see their movements



The Scientific American Digest

Conducted by F. D. McHUGH

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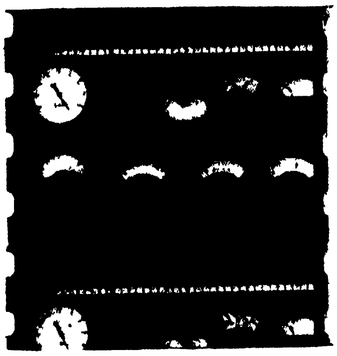
Movie Camera as an Aid in Testing

ENGINEERS, whatever their field of operations, often are required to carry out tests of various kinds where it is necessary to read a number of meters simultaneously. In such cases, several men may have to be employed to do the reading at each recording period but the results obtained are frequently difficult to coordinate. Should the test extend over, say a six-hour run, and five-second or half-minute readings be required, then the observers would probably make trouble.



Section of movie film showing how meters are read by photography

This is the substance of an address presented to the Association of Certificated Mechanical and Electrical Engineers, of South Africa, by Mr L. B. Woodworth. To overcome the many difficulties, he advocates the use of a camera, preferably a movie camera, for taking the readings. The accompanying illustration, obtained from Mr. Woodworth, will show at a glance the effectiveness of his method, and anyone familiar with tests of this nature can realize its many possibilities. As will be seen, the record obtained in this manner is permanent and may be filed away for reference at any future time. With the addition to the set-up of an ordinary clock or watch and a placard showing the date, so arranged as to be included in the picture, the resulting record would contain all facts necessary to be known, perfectly co-ordinated, and absolutely accurate. And one man can do the job in but a moment at each recording period.

Fire War on Pests

FIGHTING one forest menace with another is the solution for winning the war with bark beetles, according to David Arrivee, assistant supervisor of Targhee National Forest in Northeastern Idaho. Fire was the medium he and the Targhee forest officers used in exterminating the insects which are as deadly to the trees they infest as fire itself. He explains, in *American Forests and Forest Life*, magazine of the American Forestry Association, the method employed and compares its advantages of speed and reduced costs to the tedious felling and burning of infected trees.

Yellowstone National Park itself might have been infected by the insidious enemy had the officers of Targhee National Forest not been successful in their crusade.

"Unlike fire," points out Mr. Arrivee, "insect infestations send up no black and pungent-smelling smoke signals. The myriads of little black beetles, each smaller than a grain of wheat, show themselves only during the short midsummer mating flight, attack a tree at the rate of one pair for each of the hundreds of pitch tubes that usually exude from the entrance holes on the trunk, and then attend strictly to business under cover of the bark."

Bark beetles work swiftly both in killing the tree attacked and in spreading to others in the vicinity, and their damage is often as deadly as fire. In the race for winning the territory back from the enemy the foresters hit on the scheme of fighting with controlled fire.

"In this treatment," says Mr. Arrivee,

In the war against the bark beetle, the man whose job it is to exterminate the pests, is equipped with a small pump tank of kerosene. He sprays this liquid on the tree, lights it, and burns out the insects

"oil is sprinkled evenly over the trunk of a tree with a small pressure pump carried on the back. The oil is lighted and the tree trunk is enveloped in a sheath of flame, which chars the bark and cooks the beetles, larvae, and eggs. Directing the oil stream quickly up and down the trunk, the treater gives it an even, thin coating, with an extra dash around the base where the bark is thick Striking a match, he tosses it at the foot of the tree and with the oil stream carries the flame up and around it, placing an additional amount of the fuel as high as he can reach up tall trees to make the fire 'crown' through to the tip."

That this method is economical as well as efficient is borne out by Mr. Arnivee's statement that, "Computing the cost of equipment, labor, hauling, team hire, fuel, camps and supplies, the 1929 Targhee projects cost forty-six cents a tree, compared to the reported cost of $1.70 a tree on similar projects where the method of cutting, piling, and burning is practiced. Also, the oil-burning treatment takes only about one tenth as much time."

The tree, of course, is killed but the insects would do the job anyway and, were they not checked, would multiply and kill many other trees.

Air Traffic Control Systems

THE Aeronautics Branch of the Department of Commerce has appointed a special committee on standard signal systems for airports, in an endeavor to bring about uniformity in such systems. The results of the inquiry so far have emphasized the facts that the existing systems leave much to be desired and that they lack uniformity.

Sirens are in use at a few of the larger airports and are quite effective in conveying information to ground operators. Sometimes varicolored flags are in use. At a western airport, red and green semaphores are operated from a control tower. The Very pistol, red and green illumination of the wind tee, and blinking of the boundary lights are night-signaling methods.

The majority of those canvassed in the inquiry stressed the value of radio communication.

One authority proposes separate areas for landing and taking off, and stop-and-go lights at the head of the take-off runways. An airport engineer favors a visual system complete in itself and aural and radio signaling as auxiliaries. A system employing steam jets to be illuminated at night will be installed at an eastern airport. At another in the middle west it is proposed to install a panel of lights which will indicate the number of planes in the air at any particular time.

The committee invites suggestions from all persons interested in this topic--*A. K.*

Elmer A. Sperry

ON June 16, Elmer A Sperry, who has been ranked second only to Thomas A. Edison in the field of American invention, died in Brooklyn, New York, at the age of 69. During an active life, he had taken out nearly 400 patents. Among these, the most notable, perhaps, is the Gyro-stabilizer for ships, a device which he later modified for use on airplanes and aerial torpedoes.

He invented the Gyro-compass which is used widely on ships of many nations, and "Metal Mike," the automatic steersman which keeps a ship on a set course. He applied the gyroscope to airplanes to give pilots an artificial horizon for flying in fog. Some of his other inventions are: systems of street lighting, lighting system for motion picture projection, high-powered searchlights, and electro-chemical processes.

Mr. Sperry was President of the Sperry Gyroscope Company until January, 1929, when he sold out. He was the founder and a charter member of the American Institute of Electrical Engineers and of the American Electro-chemical Society. He was also a member of many of the most important scientific and engineering associations and societies in this country, and had received many awards and medals both at home and abroad.

New Alloy in Plumbing Industry

THE British discovery of a new ternary-lead alloy—with which it will be possible to produce sheets and water pipes superior to and cheaper than those made of pure lead, and having only two thirds of the weight, has been announced. The new alloy, which was discovered by the British Non-Ferrous Metals Research Association in the course of investigations to find the cause of breakdowns in lead cable sheathings, consists of 98.25 percent lead, 1.5 percent tin, and 0.25 per cent cadmium. Tests show that it possesses the following advantages over pure lead: Pipes made from it will be cheaper, having only two thirds the weight; its ultimate tensile strength is 84 percent greater, its resistance to vibration is 217 percent greater; in certain corrosive waters its resistance is superior to lead itself.

This curious animal portrait, found on a maple board in a shop of the Forest Products Laboratory, Madison, Wisconsin, was produced solely by a natural discoloration around a cluster of knots. The teeth and the high light around the eye were produced by reflections from the light used by the photographer

No shaft or belt turns the fan on the new Westinghouse electrical refrigerator. Powerful cobalt steel magnets, a recent development of the company's engineers, whirl the fan around by magnetic induction, through the end bell of the motor housing. The motor armature has no mechanical connection with the outside, as it runs in bearings within the housing. This construction allows the motor housing to be permanently sealed

A ton of ternary alloy costs 10 percent more than lead, taken on the basis of metal costs, but the ternary alloy will give 33⅓ percent greater length and superior mechanical strength of pipe, for the same weight of lead, so that there is a gross margin of saving amounting to 23 percent. There is a small extra manufacturing cost but the net savings make the alloy pipes considerably cheaper. Another saving will be on carriage charges. Lead sheets are subject to "creeps." The tin-lead alloy, which has a greater resistance to corrosion, is 300 percent less ductile than lead.

There seems to be good reason to believe that this alloy will take the place of lead pipes and sheets throughout the world.—*A. E. B.*

Food Poisoning

A CONSIDERABLE number of people in Chicago were poisoned after eating cake. It was formerly thought that food poisoning was due to the development of strange chemical substances in the bowel. Recent investigations have proved, however, that the effects are almost invariably due to bacteria or bacterial production. The most serious type of food poisoning is that following the ingestion of the botulism germ or of its poisons. Investigations made by Prof. E. O. Jordan of the University of Chicago have shown that other forms of bacteria likewise produce such changes. When samples of the cake were brought to the laboratory and subjected to bacteriologic examination, it was found that a staphylococcus of the type that ordinarily causes infection of the skin had developed a toxic substance in the cake and when a filtrate containing this toxic substance was swallowed by human volunteers they developed nausea, dizziness, and prostration, exactly as did the people who ate the cake.

In this experiment 80 feeding tests were made on 58 male volunteers who were mostly between 20 and 30 years of age. In an attempt to control the psychology of the situation some of the volunteers were given milk without any of the toxic filtrate. Usually there was slight rise in temperature, then dizziness, loss of appetite, weakness in the legs, headache, pain in the abdomen, nausea, and vomiting. Following this there was looseness in the intestinal action and then gradual recovery. Such conditions emphasize anew the importance of careful sanitation in the preparation of food.—*M. F.*

Seamless, Endless Tube Made by Electrolysis

BY forever pulling off the metal sheath as it is deposited out of solution on an iron alloy core, Prof. Jean Billiter of the University of Vienna makes seamless and endless tubing of copper, zinc, and iron.

But this, his first method, was too slow, he told the American Electro-chemical Society in St Louis recently, only a few inches of tubing could be made in an hour. Therefore a faster method was devised.

A lead core is now run continuously through the solution and metal is deposited on it as the core moves. Then the soft lead is melted away and the copper, zinc, or iron tubing left. A tube five yards long and nearly one tenth of an inch thick can be made in 24 hours.—*Science Service.*

"Electrolene" to Supply Cheap Hydrogen

ELECTROLENE! There's a new, synthetic name for a brand new arrival in the industrial chemical family. An appropriate name it is too, for electricity is its daddy. Electrolene is the name given by F. P. Wilson, Jr., of the General Electric Company to the new industrial gas produced by the latest ingenious contrivance of the famous Schenectady laboratory. The machine will also produce carbon monoxide or carbon dioxide or a mixture of all of them.

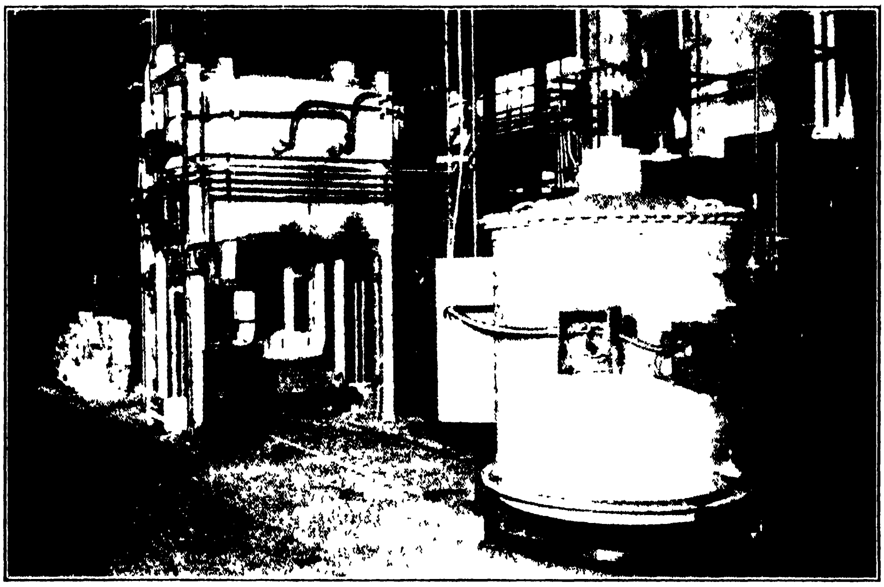
Briefly, the Electrolene producer is an electric furnace in which hydrocarbon gases, with or without steam, are partially decomposed to produce mixtures having carbon monoxide, hydrogen, and carbon dioxide as the main constituents. The relative quantities of these gases in the mixture depend upon: (1) The hydrocarbon being treated, (2) The temperature to which it is heated; (3) The amount of steam used

The hydrocarbon used as raw material may be butane, propane, ethane, city gas in which methane is the principal hydrocarbon, or a great variety of other gases.

There are dozens of operations in the chemical industry where chemists would use large quantities of hydrogen except for the high cost of the gas that forces them to adopt other expedients. Now comes an electrical device which supplies, not pure hydrogen, it is true, but a gas mixture which will, in many cases, do just as good a job, at about one tenth the cost. If methane is fed into the producer operated at 1400 degrees, Centigrade, the result will be hydrogen and CO; if carbon monoxide and steam are fed into it, the Electrolene will be a mixture of hydrogen and carbon dioxide, the proportion depending on the temperature of the producer. The electric heat supply is automatically controlled to maintain any desired temperature, and the steam supply is also automatically regulated for any rate of output, so that one valve controlling the Electrolene flow from the producer is the only part of the equipment requiring manual attention.

In every case an appreciable increase in volume of raw gas supplied appears as Electrolene. In the case of complete dissociation of coke-oven gas with steam one cubic foot of raw gas becomes approximately two cubic feet of Electrolene, having an approximate analysis of 72 percent hydrogen, 23 percent carbon monoxide, and 5 percent of "inerts." From butane, a volume increase of 13 times is secured, the resulting Electrolene analyzing approximately 69 percent hydrogen and 31 percent carbon monoxide. With methane, the volume increase is four times, and the Electrolene analyzes about 75 percent hydrogen and about 25 percent carbon monoxide.

For a great variety of industrial uses, Electrolene promises to be an effective answer to the chemist's prayer for cheap hydrogen.—*A. E. B.*



Electric annealing furnace and Electrolene producer

Canned Salmon Prevents Disease

CANNED salmon contains the substance which will prevent the frightful hard-times disease, pellagra, the United States Public Health Service has just announced. Canned salmon may therefore be substituted for meat in localities where pellagra is prevalent but where meat is scarce.—*Science Service.*

Detecting Dangerous Sewer Gases

ABOUT a year ago, a series of explosions in a sewer in London ripped up pavements and shattered building fronts over a wide area. Just a few weeks ago, a similar explosion in a sewer on Broadway, New York, caused considerable damage. Such accidents emphasize the ever-present danger, not only of serious property damage but also to the men of maintenance or inspection crews due to the accumulation of various gases such as carbon monoxide, ordinary sewer gases, and the fumes from oil wastes, in manholes or sewers beneath our streets.

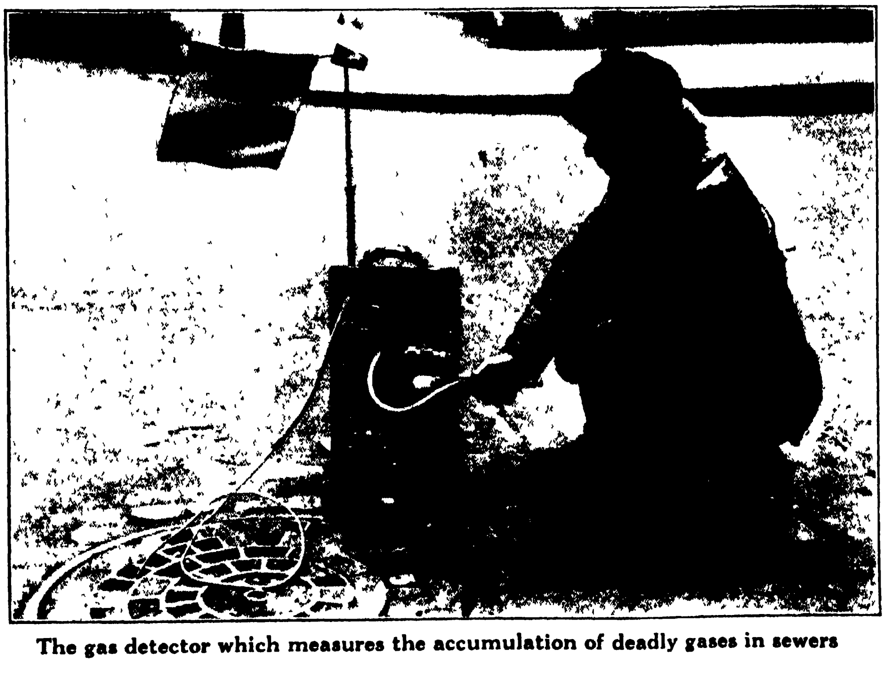
To check up on this gas accumulation, the Mine Safety Appliances Company has developed the Jones Gas Detector, an easily portable outfit mounted in a small stand It consists essentially of a bomb in which a spark plug is inserted and to which a pressure gage is attached. In addition, there are the following component parts. A measuring device, cylinder of propane, water cup, aspirator bulb, two dry cells, an automatic spark coil, ignition switch, necessary valves, and so forth. (One cylinder of propane, in compressed liquid state, is sufficient for making approxi-

Testing for carbon monoxide gas in a manhole with an ampoule mately 300 tests as described below.)

In operating the Jones Gas Detector, a sample of the air to be tested is drawn up from the sewer and forced into the apparatus through a suitable length of sampling line by means of an aspirator bulb. The sampling line is then detached and the aspirator bulb is connected to the rubber inlet tube which traps the sample in a closed system. Stopcocks on each side of the bomb are closed and a spark introduced into the bomb by snapping the ignition switch momentarily to the "on" position and then to the "off" position. In this manner, an explosive gas-air mixture is ignited and the pressure developed by the explosion in the bomb is indicated on a drag needle pressure gage. If no pressure in indicated by this procedure, the sample is enriched by the addition of a measured volume of propane which displaces an equivalent volume of sample. After this propane is thoroughly mixed with the sample by aspirating through the closed system, the stopcocks are closed and a momentary spark is introduced. An explosion in the bomb indicates that the original sample is not less than 75 percent explosive since the measured volume of propane added is equivalent to 25 percent of an explosive propane-air mixture. If no explosion is indicated in the bomb after the first enrichment, it may be necessary to make three more individual additions of propane to the original sample, following the same procedure as with the first to determine if the original sample is approximately 50, 25, or less than 25 percent explosive.

If there is no initial explosion in the bomb and no further explosion upon the addition of a fully explosive concentration of propane, the original sample consists either of an inert atmosphere or explosive gas in concentration above the upper explosive limit. To determine which of these two conditions exists, further simple tests are made according to directions supplied.

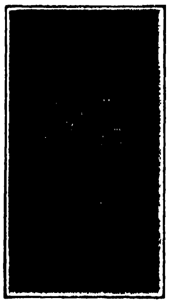
To detect the presence of that most treacherous and deadly gas, carbon monoxide, the above company produces the M-S-A Carbon Monoxide Detector Ampoule. This consists of palladium chloride in an acetone-water (non-freezing) solution, sealed in a small glass tube which is surrounded with absorbent cotton. The ampoule is first attached to a string, crushed between the fingers until the cotton is fully saturated by the escaping solution, and then suspended in the manhole for 10 minutes The solution turns the cotton a yellow color In the presence of carbon monoxide, it turns black. The degree of grayish or black discoloration, compared to a chart, indicates the carbon monoxide concentration It is claimed that concentrations as low as 03 percent can be determined with this ampoule.



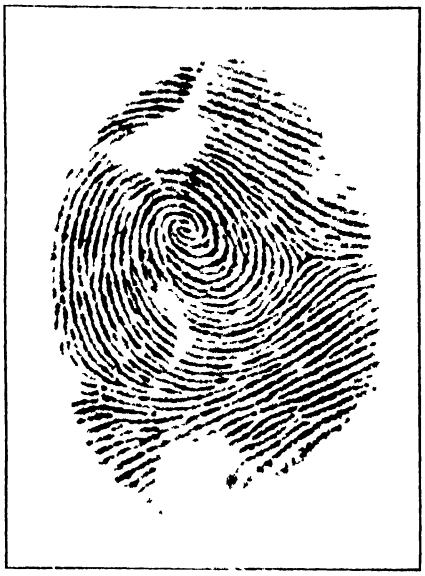
The gas detector which measures the accumulation of deadly gases in sewers

City Trees Often Gassed

SHADE trees need pure air just as people do. Trees are often killed by illuminating gas from leaky pipes in the soil, says the United States Department of Agriculture. Recent experiments show that gassed trees may be saved, if they have not been exposed too long, by forcing air or oxygen under pressure, through a specially constructed nozzle, well into the ground at different points around the tree so as to displace the gas It will be necessary, of course, to find and stop the gas leak or the procedure will have to be repeated.



At the left is a fingerprint raised from the irregular neck of a bottle by means of the new fingerprint lifting tape. At the right is the same print (reversed) as it appeared when the lifted print was photographed on bromide paper enlarged for comparison



Fingerprint-Lifting Tape

A SPECIAL tape of black rubber which simplifies the raising of a latent fingerprint, has recently been invented and patented by Major Richard M. Joyce, Superintendent of the Bertillon and Criminal Identification Bureau of the St. Louis Police Department. Latent prints are to be distinguished from those intentionally made on suitable surfaces for record purposes; they are those which are inadvertently left behind by criminals at the scenes of their crimes.

The old photographic method of obtaining permanent records of latent prints has many disadvantages. Prints left on curved, angular, or reflecting surfaces or in restricted recesses are almost impossible to photograph, and when a camera is used the resulting images are distorted or indistinct. By Major Joyce's method, the print is first powdered with aluminum bronze powder, the tape is pressed over this, and the gleaming print is lifted. The image is then covered with a transparent shield which protects it until it may be conveniently photographed.

This new transfer system extends fingerprint recording facilities to small towns or rural districts not able to purchase and operate the usual photographic equipment.

Aluminum in Colors

WHILE aluminum, together with its alloys, has been adopted for a wide variety of uses, (see SCIENTIFIC AMERICAN, June, 1930), its many possibilities have only begun to be realized With the production of aluminum in colors by a recently developed process, some of the advantages of the metal have been enhanced and some of its disadvantages overcome so that interesting new fields for its application have been opened up.

Colored aluminum, called Alumilite, was developed by the Metals Protection Corporation. The process is an electrolytic method of applying protective and decorative coloring to aluminum and its alloys, the colors available being silvery white, jet black, and various shades of red, blue, yellow, brown, green, and purple

The developing company makes the following claims for the new product:

The coating is an integral part of the aluminum itself, will not crack or peel, and sheets so treated may be stamped and formed into such shapes as camera bodies, hub caps, trim, et cetera, without marring the finish. Alumilite offers unusual resistance to atmospheric and salt-water corrosion, and although not recommended for use in protecting aluminum against acids and alkalis, it is effective against certain chemicals. Alumilite will not withstand cutting by a sharp instrument but offers considerable resistance to it. A blunt instrument will force the coating into the softer metal beneath without rupturing. Alumilite-treated metal can be heated above the melting point of aluminum, 1214.6 degrees Fahrenheit, and the metal within will melt while the coating remains intact. The treated aluminum surface will absorb certain lacquers as well as oil and is, therefore, a good base for such materials, ordinary aluminum is not.

Some of the suggested uses of Alumilite are cameras, scientific instruments, novelties, electrical appliances, switch plates, fittings, automotive trim, airplane propellers, marine equipment, optical goods, toys, aluminum shingles, and many others. Black, for example, has been suggested for the bottoms of cooking utensils, since black absorbs heat more readily than any other color. Water in an aluminum kettle blackened by the Alumilite process will boil in much less time than in a plain aluminum kettle.

Alumilite has been adopted by many large firms for use on their products, by the Navy Department for use on airplanes, submarines, et cetera, and by Army aircraft engineers for use on Army airplanes.

Overweight Children

THE fat baby has always been a pride to its parents, but the fat child of eight to 20 years of age is a problem for its parents. Many cases of fatness or obesity are due to disturbances of the glands of internal secretion, or to the fact that the body does not dispose properly of the material that is taken into it. In many instances, children are fat because the parents and grandparents were fat. This is known as constitutional obesity and is the type that is absolutely resistant to all treatment. In those cases of obesity due to glandular disturbances, the basal metabolic rate or the rate at which the body carries on its chemical process is lower than it should be. However, in many cases of constitutional obesity the basal metabolic rate seems to be normal.

Drs Anne Topper and Hannah Mulier have made a study of the basal metabolic rates of 35 boys and 35 girls whose ages ranged from six to 14 years, but whose weight exceeded normal by from 13 to 75 percent. In many cases there was a definite indication that the children had been overfed. Naturally only a few confessed to laziness. In some cases the obesity followed recovery from acute infectious diseases or following removal of tonsils or the appendix. In the large majority of these cases, however, it was found that the metabolic rate was normal, in a great many cases being toward a high normal rate. The authors believe that the tendency toward a high normal rate is probably due to overfeeding and to the fact that the body is forced to speed up its activities in order to take care of the excess food.

It should be recognized that these examinations were made in many instances just before the time of adolescence when the child begins to change toward the adult type. At this time the glands in the body undergo various changes and these changes may be associated with the rather high increase in the speed of metabolism.

Obviously, the practical lesson to be derived from this discussion is the necessity of determining how much food is necessary to keep the child at normal weight and thereafter to avoid overfeeding.—*M. F.*

Light Alloys

THE lightest element solid at ordinary temperatures is the metal lithium. It is only a little more than half as heavy as water. While technically a metal, it is too soft to be of any use in the ordinary applications of metals and too active chemically, for it tarnishes rapidly in the air and is completely changed by contact with water, which it decomposes.

In recent years, however, says R. M. Santmyers, of the United States Bureau of Mines, considerable research has been made to determine the possibilities of alloying lithium with other light metals such as beryllium and aluminum. A patent has been issued to Frank A. Fahrenwald for an alloy of extreme lightness, fair permanence, and considerable hardness, in which the component parts were lithium and beryllium. The beryllium protects the lithium from oxidation by moisture or heating and from further action if oxidation has begun, by producing upon the surface of the alloy a closely adherent, finely textured insoluble oxide that prevents further oxidation. The lithium content may be as high as 25 percent. This alloy apparently does not corrode faster than iron, and its specific gravity is only about 1.5.

By increasing the proportion of lithium to about 65 percent, an alloy as light as water can be produced, and although such an alloy corrodes fairly rapidly in the presence of water it can be protected sufficiently for many purposes by plating or covering. If the percentage of lithium is increased slightly above 65 percent, small quantities of aluminium or zinc may be added to increase the hardness and strength, but the alloy will retain a specific gravity little or no greater than that of water.—*A. E. B.*

Lead lined carbon dioxide generators

Driers and screens for Epsom salts

Making the Sparkle for Soft Drinks

IN these hot summer days, the soft-drink dispensaries once more come into their own, and it is an appropriate time to consider the chemistry that creates the sparkle or "fizz" in the bottled beverages that quench the great American thirst. The sparkle is due to dissolved carbon dioxide gas—the gas that gives soda water its effervescence. While carbon dioxide is one of the most abundant gases in nature, being generated wherever coal or wood is burned, its manufacture for beverage purposes presents certain problems to the chemical engineer which are described by W. P. Heath in a recent issue of *Industrial and Engineering Chemistry*.

"Before prohibition," says Mr. Heath, "carbon dioxide was collected and compressed as a by-product of the fermentation of beer. The most recent method is to pipe it from wells. In California, prospectors drilling for oil ran into large pockets of carbon dioxide under pressure. Under government lease these pockets are now yielding their store of carbon dioxide. Most of the gas thus collected is used in the manufacture of solidified carbon dioxide. Perhaps the most universally used process today is the coke process, whereby carbon dioxide is collected as a product of the combustion of coke under forced draft."

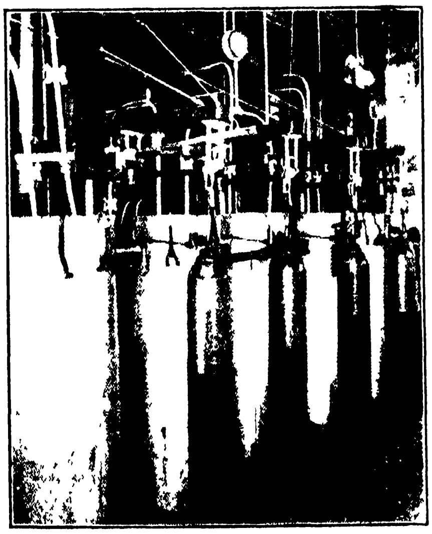
In Atlanta, because of the proximity of raw materials, the Crystal Carbonic Laboratory uses the wet process, with dolomite, sulfuric acid, and water as raw materials. The stone called dolomite is most suitable on account of its freedom from excessive amounts of oxide of iron and alumina, carbonaceous matter, sulfides, and silica. The stone is pulverized and then treated with sulfuric acid. Carbon dioxide is given off rapidly, and the gas is piped to a 2500-cubic-foot rubber gas bag in the basement, where it is ready for compression. The gas is drawn from the gas bag into a three-stage compressor where the pressure is stepped up to 75 pounds in the first stage, 250 pounds in the second stage, and 1000 pounds or more in the third stage. The third stage of this machine is of the solid-plunger type, outside packed, and the gas emerges at over 1000 pounds pressure into brass cooling coils, where the temperature is reduced to below 88 degrees, Fahrenheit, the critical point of carbonic acid. The gas is then forced into 50-pound steel drums. Gases under pressure are classed as hazardous and the filling is carefully regulated so that all excessive pressure may be avoided.

At ordinary temperature the drums are about two thirds full of liquid and one third full of saturated gas. The average purity is 99.5 percent and there are traces of air. Such impurities as may give an odor or taste are not permitted in carbonic acid to be used in the beverage industry.

One of the most interesting features of this process is the fact that it produces Epsom salts as a by-product. The dolomite contains 45 percent of magnesium carbonate, and after the sulfuric acid has acted on this substance, releasing the carbon dioxide gas, there remains a solution of magnesium sulfate—Epsom salts. Although the Crystal Carbonic Laboratory is primarily in the business of manufacturing carbon dioxide for use in the beverage industry, the quantity of magnesium sulfate obtained as a by-product makes this company one of the largest Epsom salt manufacturing concerns in the United States.—*A. E. B.*

Bread

THE battle of cultists against white bread continues. The millers oppose the attacks by pointing out that the American people seem to prefer white bread to whole wheat bread. Furthermore, they are annoyed because there has been a general decrease in the consumption of cereals, since these represent a cheap source of energy and the American people have become accustomed to expensive diets. The bread of today is not the bread of the past generation. Today it is made by the addition of milk, nuts, raisins and other substances which add greatly to its nutritious value.



Compressed carbon dioxide being loaded into cylinders for shipment

Whole wheat is preferred by some because of its bran content and its greater proportions of vitamins, due to the fact that the whole wheat germ is present. On the other hand, whole wheat bread does not keep well and the bran is irritating to persons having inflammations of the gastro-intestinal tract.

Under the auspices of the Medical Research Council in Great Britain, Drs. R. A. McCance and R. D Lawrence made a special study of this problem. Their views are succinctly stated

"In advocating whole-meal bread for general use, whether in times of need or in times of plenty, it should be remembered that not only men but also women and children are concerned, and that all the experiments on which the arguments are based have been carried out on animals or adult males. Children are very intolerant of high cellulose diets, and, for some, brown bread is far too irritating, even if given with the idea of relieving constipation. Appetite is such an important factor in all digestive considerations that no one who dislikes a food of unproved value should be forced to eat it if it can be avoided. In time of peace, of course, the grown-up population, if they have the choice, will never eat whole-meal bread unless they like it, no matter how specious the advertisement, but they may force their children to eat it in the belief that they are doing them good. One should, therefore, be cautious in advising whole-meal bread generally, and wait until careful unbiased experiments have been done on a sufficient number of men, women, and children Thus only can accurate conclusions be drawn "

It must be remembered that man does not live by bread alone In a suitable diet, bread constitutes only a single part and is supplemented by meat, vegetables, fruits, and many other cereal products In the light of present dietary habits, there seems to be no reason to believe that white bread is in any sense of the word a harmful constituent of an average diet. -*M. F.*

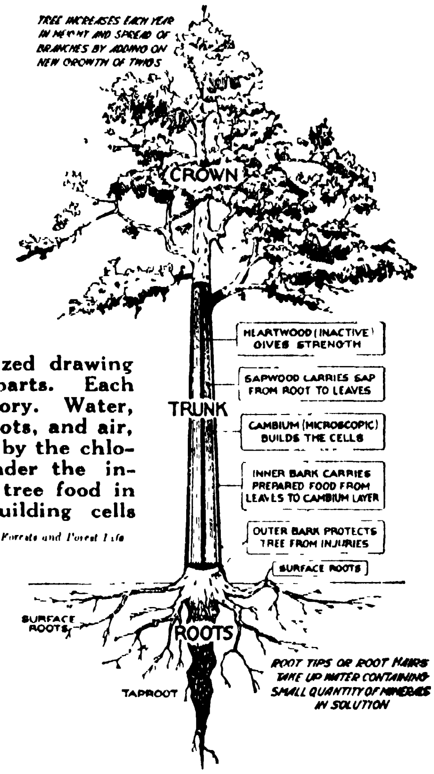
Navigation in the Air

AERIAL navigation is not a matter largely of astronomical observations. It is, particularly for cross-country work, a matter of dead reckoning, with compass, drift and speed indicators, and a few simple calculations as its basis. It is not a difficult art, but an immensely important one. The subject is splendidly covered in "The Navigation of Aircraft," by Lieutenant Logan C. Ramsey, U S. N , himself a naval aviator and an acknowledged authority on aerial navigation.—*A. K.*

A Novel Landing Float

IN *Aviation* is described a novel form of semi-circular "button" float which has been placed in use on the Air Ferries [See page 379, May 1930 SCIENTIFIC AMERICAN. *Editor.*] between San Francisco-Oakland and San Francisco-Vallejo; more than 85 landings are made on it daily

The float is rigid, with a smooth rounded top which slopes gradually into the water. A sand surface is provided to keep the planes from skidding. The float is supported by a pontoon and fitted with an overhanging platform. Along the rim are four solid ballast pockets to regulate the depth still more accurately. At the water line 18 buoyancy tanks are installed to correct any tendency of the float to be too lively. The surface of the float is a variable curve for the purpose of breaking rough water and to give maximum freeboard.



TREE INCREASES EACH YEAR IN HEIGHT AND SPREAD OF BRANCHES BY ADDING ON NEW GROWTH OF TWIGS
CROWN
HEARTWOOD (INACTIVE) GIVES STRENGTH
SAPWOOD CARRIES SAP FROM ROOT TO LEAVES
TRUNK
CAMBIUM (MICROSCOPIC) BUILDS THE CELLS
INNER BARK CARRIES PREPARED FOOD FROM LEAVES TO CAMBIUM LAYER
OUTER BARK PROTECTS TREE FROM INJURIES
SURFACE ROOTS
SURFACE ROOTS
ROOTS
TAPROOT
ROOT TIPS OR ROOT HAIRS TAKE UP WATER CONTAINING SMALL QUANTITY OF MINERALS IN SOLUTION

How a tree grows: A partly sectionalized drawing showing the functions of the various parts. Each leaf is essentially a tiny chemical factory. Water, with its dissolved minerals, from the roots, and air, which the leaf breathes, are acted upon by the chlorophyll—the green coloring matter—under the influence of sunshine and the result is tree food in the form of sugars and starches for building cells

Courtesy American Forests and Forest Life

The weight of the float is 100 tons and it extends 4½ feet under water. It is built of creosoted Douglas fir and is moored by a cable from a king post to keelsons leading to the rim and then to anchorage. It cost 10,000 dollars to build.

When the amphibian alights on the water, its wheels are dropped and it climbs out of the water on to the button under its own power It can approach from any direction without the help of landing crews, and can also make a get-away unaided.

Experiments have shown that a complete circular float, slowly rotated, will divert the wave, kill a hollow and make the approach of the plane easy even in a high sea. This makes the use of the float promising even at sea

It was developed by B. L. Haviside and Joseph J. Tynan, Jr , both of San Francisco, and is arousing much interest.—*A. K.*

Max Valier: Rocket Martyr

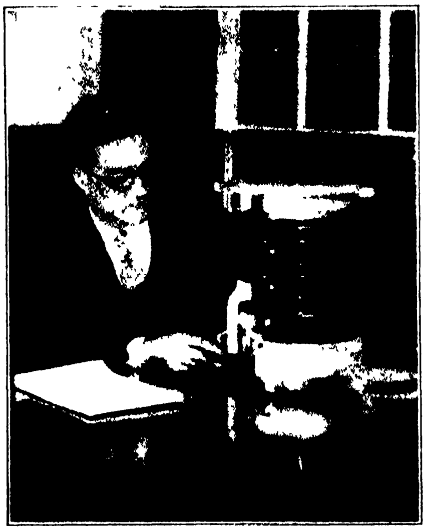
THE month of May saw the sad crash of Max Valier in a venturesome plane flight propelled by liquid rocket. The whole fuel charge detonated at once.

The internal combustion engine, the cannon, and the rocket are all heat engines operating on the same fundamental calorific principle A 16-inch shell, for example, has the energy of an express train, a rocket may possess the energy of an ocean liner.

In the 90's a German and a Russian (Ziolkowski) were developing on paper the concept of space ships, rocket-propelled;

and in 1913 Robert Esnault-Pelterie, the distinguished creator of the French aeronautic engine, delivered a mathematical paper on "Astronautics" before the St. Petersburg Academy. The science, or art, has been more fittingly renamed by a German "Kosmonautics."

Parallel, then, with the laboratory work of our own Dr. Goddard, a close group of Germans and Austrians, and a corresponding group of Russians of the Hydrodynamic Institut, have been working systematically toward the solution of the problem. In the German group were prominently: Dr. Oberth (Hirsch-REP prize 1928-9); Ingr. Hohman (Honorable Mention); Max Valier, Ingr.; Fritz Opel, manufacturer; A. Scherschewski; Sander, pyrotechnist; Willy Gail and Frau Harden, writers; Rhoen-Rossiten Gesellschaft; pilot Stammer, and a number of others. Their headquarters are at Breslau. The UFA has collaborated, and even made a "moon" film. The equivalent American society is the American Interplanetary Society, at the American Museum of Natural History.



Mr. McEachron with a sectionalized Thyrite lightning arrester

Valier was the principal proponent of working toward the space craft or vehicle from the known forms of surface or air craft. For example, he proposed first to drive a boat with rockets (which Opel tried); then an automobile (reported speed 230 miles per hour); then a rail car (reported speed 300 miles per hour); then an ice sledge (still faster); and recently a light plane (60 miles an hour by Stammer, July 1928, the first man so to fly). Valier at the time of his death was substituting oil fuel for gunpowder in the expulsive jet, preparatory to hopping the channel at a speed hoped to be about 100 miles per hour.

A National Advisory Committee report has demonstrated that jet propulsion is not efficient at aircraft velocities—indeed at less than the speed of sound, for flame jets. But beginning with projectile velocities, and up to a mile or so a second, the jet principle approaches an efficiency of 70 and 80 percent, or better than any other heat engine. It is this happy circumstance, more than any other factor, that gives one confidence in the ultimate solution of Kosmonautics.

The name Valier should be placed beside those of Icarus and Lillienthal.

Two Freak Metals Find New Uses

TWO rare metals, caesium and rubidium, formerly known as chemical curiosities, have found their first important commercial use as a result of the development of radio and photo-electric cells. Both these queer metals, members of the alkali group, are soft enough to be cut with a knife and have to be kept in a vacuum, else they ignite spontaneously, due to their extreme chemical activity. This very property is now being utilized in the manufacture of radio tubes. The caesium is introduced into the tubes in the form of chloride, mixed with magnesium or calcium, and compressed into small tablets or "pills" At one stage in the manufacture of the tube the pill is flashed, eliminating the last trace of air and thus securing the desired vacuum. The caesium chloride supplies positive ions at the surface of the filament.

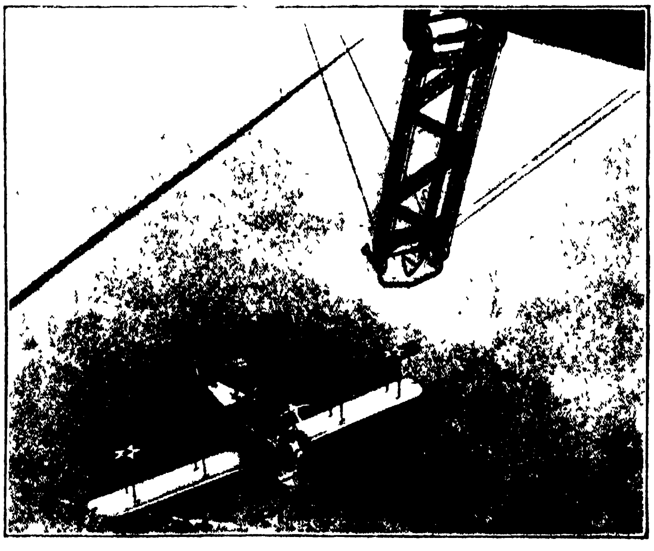
Both caesium and rubidium are employed to a limited extent in the manufacture of photo-electric cells. Rubidium, however, appears to be more suitable for this than caesium, because an extremely thin layer can be applied on the inner side of the glass. In the manufacture of these cells the metal. either caesium or rubidium, is introduced in excess but later is removed entirely except for the molecular layer that has formed on the silver or other base-metal electrode. The photo-emission of the molecular layer is greater than that of the massive metal.—*A. E. B.*

Thyrite—Both an Insulator and a Conductor

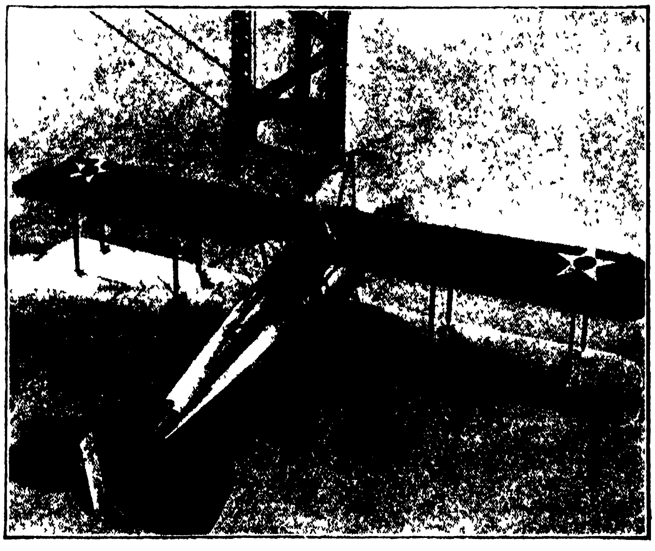
AN entirely new type of material, one that is both a good insulator and a good conductor of electricity, was announced by K. B. McEachron of the General Electric Company recently in New York City. This material, which has been called Thyrite, meaning gate or valve, has the remarkable property of changing its resistance to the flow of electricity as the voltage or pressure is changed. This change in resistance is such that each time the applied voltage is doubled, the resistance decreases so that the current flow is increased more than 12 times. This means that if the voltage is increased 16 times the current flow is increased more than 25,000 times.

The usual conductor with which electrical engineers are familiar does not change in resistance except when the temperature of the conductor changes. To illustrate: the tungsten filament in the Mazda lamp increases its resistance considerably as the filament heats up; the carbon lamp shows, on the contrary, a decrease in resistance as the filament increases in temperature. With either of these materials the resistance change is slow since it depends on the time required to heat the filament. Unlike any materials now in commercial use, the resistance change of Thyrite does not depend on the temperature, but on a change in the applied voltage. Thyrite will change its resistance as quickly as the applied voltage changes; in fact, tests have shown that the resistance can be decreased to a millionth of its original value in a time as short as a millionth of a second.

Thyrite is a manufactured product which required more than five years of intensive research to develop to the state where it can be produced commercially. Mr. McEachron exhibited some disks six inches in diameter and three-fourths of an inch thick, made for use in lightning arresters for the protection of power stations against the damaging effects of lightning. Such disks have a resistance of about 50,000



The dural framework which extends from the lower part of the airship frame, and a plane maneuvering for "hooking" position. Tests of the device were successful



The slight impact that ensues after hook and bar meet is evidently sufficient to adjust hook so that it is securely attached. Note construction of plane hook

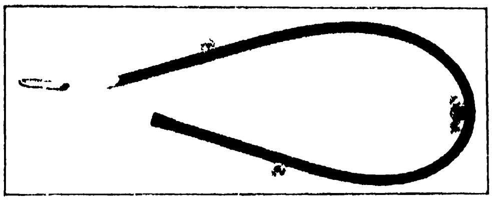
ohms when 100 volts are applied to the parallel faces; the resistance decreases to less than one half an ohm when the voltage is increased to 10,000 volts. These disks of Thyrite will carry lightning discharges as heavy as 30,000 amperes without any sign of distress.

The characteristics of Thyrite are permanent. Some of the first material made is still on life test, with no change in its characteristics, even though it has been carrying current continuously night and day over a period of several years.

Thyrite resembles black slate in color. It has mechanical properties similar to those of dry-process porcelain. In manufacturing it, the material is moulded to the shape required, and the contact surfaces coated with metal by the Schoop metal-spraying process.

It is possible to use the material successfully on any alternating or direct current circuit, it is necessary only to supply a proper amount of the material so that it will not become overheated.

In connection with lightning arresters, Mr. McEachron explained that the use of Thyrite allows a considerable reduction in the space occupied by the arrester, and that it is possible to calculate its performance accurately. This feature will be of great assistance to engineers using such protective equipment. Furthermore, it was pointed out, it is possible for anyone to determine the characteristics of Thyrite over a considerable current range, without the use of expensive equipment.



The rubber tube with which a safety pin was removed from the position in a patient's stomach as shown in the illustration above at right. It was not necessary to open the wall of the stomach although the abdomen was cut open

Aeronautical Equipment

THE Curtiss-Wright aeronautical equipment catalog of some 250 pages is a comprehensive compilation. Nothing gives a better idea of the number of things that go to make up aviation: airport equipment, books and maps, cable and wires, clothing, engines and engine accessories, fuels and lubricants, instruments, landing gear and parts, propellers, and so forth. It is a catalog which should be in the hands of every pilot and plane owner.—*A. K.*

Launching Planes from Airships

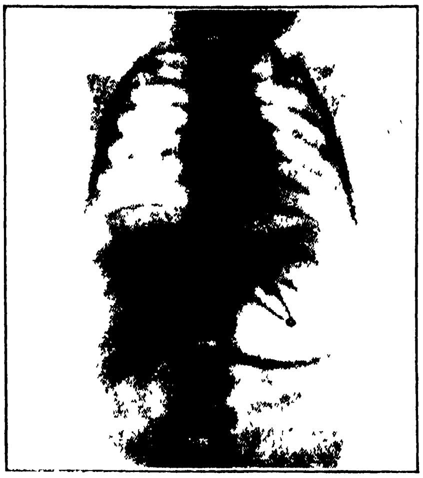
ONE of the two accompanying photographs shows a Vought UO-1 Navy Observation plane approaching the *Los Angeles* prior to "hooking-on." The airplane is provided with a frame superstructure into which the weight of the airplane is transmitted without undue local stresses being set up. At the top of the superstructure is a hook which has apparently some flexibility and is controlled by a sort of large spring. From the lower part of the airship frame there extends a dural framework, suitably braced with wire and carrying a bar at its lower end.

When the airplane is about to be hooked on to the airship, the speeds of the two types of aircraft are synchronized and the pilot feels his way cautiously until he can get the hook on to the bar. When the plane is to be released the bar is pulled away. Demonstrations of the hooking-on and releasing of the plane have been made several times on the *Los Angeles* and have been entirely successful. The hooking-on process enhances greatly the military value of the dirigible. The airplane, having a seped of twice that of the airship, is valuable as a scout for transmission of information to the fleet, and also provides the airship with protection against enemy heavier-than-air craft. A. K.

A Pin in the Stomach

WHEN an open safety pin is swallowed it constitutes a serious menace because of the danger that it will penetrate the wall of the stomach and set up peritonitis. So serious is this possibility that not infrequently the patient is operated on immediately and the stomach opened in order that the pin may be removed.

In a case treated recently by Dr. W. B. Huff a technique was devised which enabled the condition to be handled without opening the wall of the stomach. Ingeniously the doctor introduced into the esophagus a rubber tube with a piece of gauze at the end. The abdomen was opened, the pin felt with the fingers, and then, without opening the stomach, the pin was fastened to the gauze at the end of the rubber tube and closed. The rubber tube was then slowly withdrawn, bringing the safety pin with it. In the instance described the child recovered without further disturbance. The method seems to be of value particularly because it permits proper handling of the condition without opening the stomach wall. *M. F.*

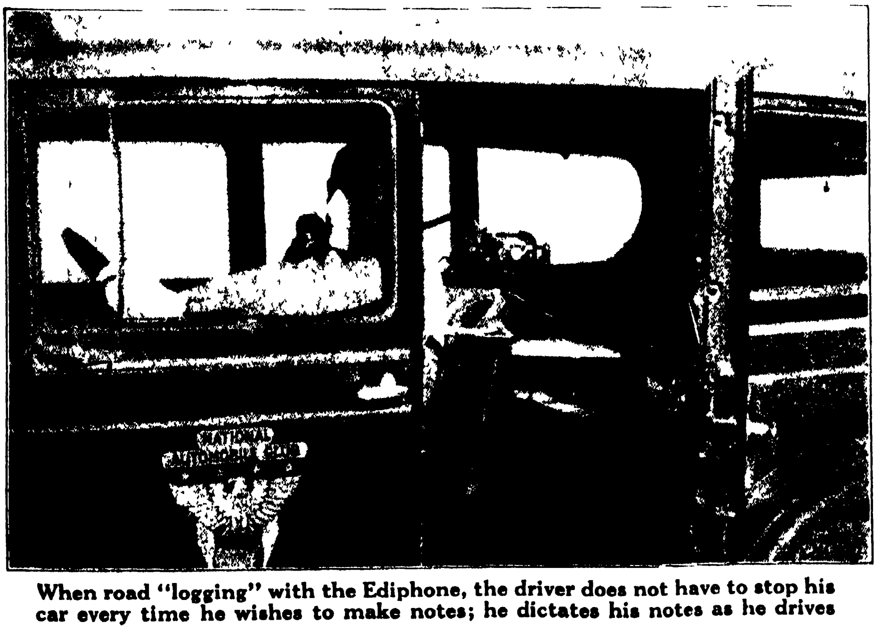


An open safety pin in a patient's stomach as revealed by the X ray

Ediphone Used for Road "Logging"

LATEST road information for the members of the National Automobile Club, San Francisco, is being gathered in a unique, modern, and efficient manner through the utilization of the Ediphone. Traveling in an automobile equipped with an Ediphone operated by a six-volt battery, a very satisfactory trial trip proved the possibility of this method of road "logging," as the collecting of data on road conditions is called.

Instead of the necessity for bringing the car to a stop or, at least, greatly reducing the speed, for the purpose of making notes, this new system enables the driver to record conditions while traveling at the usual rate of speed. Covering ground as rapidly as safety and the condition of the road will permit, the driver may collect such details as mileages, cross roads, grades, road conditions, and a general description of the country traversed. This information is recorded on the cylinder for later transcription into a typewritten report for use in the drafting of maps and the distribution of touring information to club members.



When road "logging" with the Ediphone, the driver does not have to stop his car every time he wishes to make notes; he dictates his notes as he drives

Strength of Prehistoric Monsters Dwarfed by Huge Testing Machine

THE supposed strength of the prehistoric dinosaur is dwarfed beside that of a huge testing machine installed recently at the University of Illinois.

This machine crushes steel and concrete

with as much ease as a human mashes a piece of dirt beneath his foot. It stretches iron rods as if they were taffy candy. In fact, it can exert as much as 3,000,000 pounds in either tension or compression, either to pull things apart or to squeeze them together.

Building beams 35½ feet long can be tested. The screw that is used to concentrate the great pressure is more than 57 feet long and one foot in diameter. The machine stands nearly 50 feet above floor level and extends 14 feet below. It weighs 140 tons.—*Science Service.*

Electrical Water Heater

An automatic, electrically operated water heater for which high efficiency and low cost of operation are claimed, has recently been placed on the market under the trade name Electromatic. It is adaptable for use in homes, apartment houses, doctors' offices, barber shops, beauty parlors, soda fountains, and so forth. Once it is regulated for the temperature desired, it maintains that temperature without any further attention.

The "heart" of this system is the heating element which is immersed in oil in a vacuum tube which extends down through the center of the tank. From this, a lateral tube leads off to the thermostat control which is operated by a mercury tube. Directly above the mercury tube is the switch which turns on and cuts off the electrical supply. The cold-water supply enters the tank through an inlet near its base while the hot-water outlet is at the top. The tank is well insulated against heat losses, the material used for this purpose being a high grade mineral wool packed six inches deep at the top and three inches thick around the sides.

The advantage of the vacuum oil tube is that it becomes, in effect, the heating element and thus gives a heating surface many times greater than that of the average heating device It can heat the water in less time at a lower unit area temperature. The heat of other devices is more concentrated and thus produces scale.

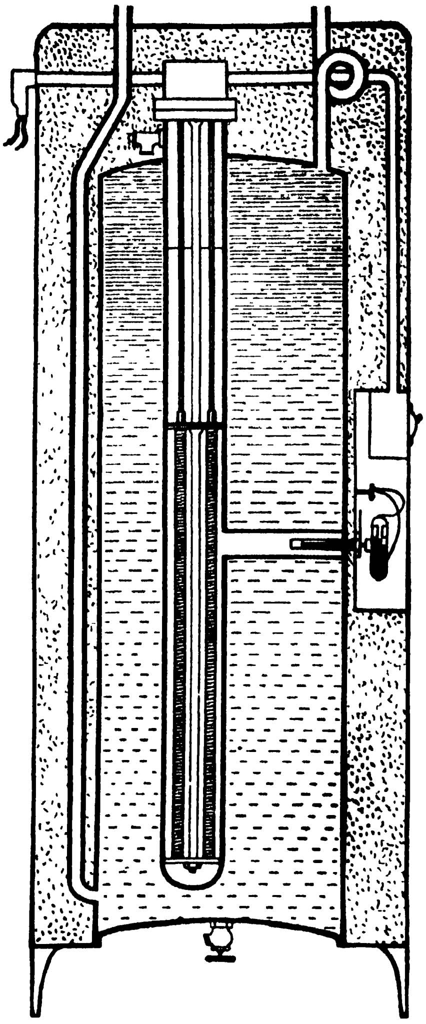
The Electromatic can be connected with any furnace or kitchen range hot-water circuit. Since it operates automatically, it will maintain the water at the desired temperature after the furnace or range heat has dropped too low to do the job.

Ants in Indian Surgery

The use of "surgical ants" with powerful jaws to stitch the wounds of human beings, and other primitive medical practices developed by the Indians living far in the interior of Peru, are described in a report received recently at Field Museum of Natural History from the Marshal Field Botanical Expedition to the Amazon.

Llewelyn Williams, leader of the Peruvian division of the expedition, had just returned to Iquitos after a collecting trip along the Amazon and some of its tributaries which took him as far as the Brazilian border. Parts of the regions explored are believed never to have been entered by white men before.

"The natives of the equatorial forest show great originality and dexterity in the treatment of wounds and illness," writes Mr. Williams. "Trees, shrubs, and plants with medicinal properties are widely employed, and a surgical handicraft in which certain insects are used has been developed.



Cross-section of new electrical water heater; controller at right

"In the case of a gaping wound, a certain ant which has very powerful jaws is sought, and the ant is made to bite the severed edges of the cut skin and thus bring them into juxtaposition. In the operation the ant-surgeon loses its own life for after it has drawn the skin closed with its jaws, its body is snipped off, and the lifeless head remains with its death grip on the skin until the wound is healed. Sometimes these Indians are found with half a dozen of these ants' heads holding a large wound closed during the long healing process.

"After inter-tribal battles, in which fighting is done with axes and machetes or bushknives, many of the warriors return home with deep, ghastly, and apparently fatal wounds. The women, however, are usually successful in treating these wounds. After bathing them, they apply ginger as a local anaesthetic. Then a plaster is made from the pulp of a weed known as 'Santa Maria,' and the wound is bandaged with a dried banana leaf. In a week or so most of the wounds heal. Sometimes the crushed body of a certain ant is applied as a salve. The injured men are placed on a diet eliminating salt and fats, and made to drink large quantities of an infusion prepared from the bark of a tree.

"Long thorns are sometimes used as surgeon's needles. The skin at one side of an open wound is pierced with the thorn, and it is then thrust across to and through the opposite skin edge, the protruding end of the thorn being fastened with string and left there until the two edges have fused.

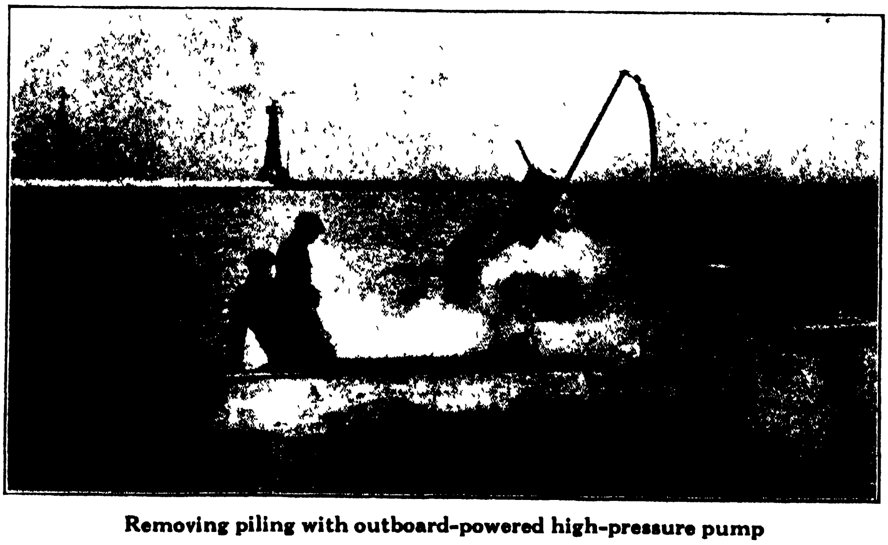
"In the wet lowlands there is a female jigger or burrowing flea which buries itself in one's flesh. There its body swells and becomes globular, being distended with a huge quantity of tiny eggs. The natives remove this by working carefully around the insect's body with a needle. Skill is necessary to avoid breaking the egg sac, for if a single egg is left in the wound the operation is valueless.

"There is also a worm which burrows into the legs of its victims, forming a swelling like a boil which breaks, and then the worm protrudes its head. Any attempt to drag it out suddenly, fails, as it tears. The natives draw a few inches out carefully day by day, rolling the exposed end around a small piece of wood. Much delicate manipulation is required, as this entozoon ranges from six to ten feet in length."

Outboard Motor Becomes a Work Horse

An outboard motor designed for pleasure outings became a work horse recently and helped to repair the ravages committed by Lake Michigan during the March storms. The pounding of the waves reduced the wooden breakwater in front of the Johnson Motor Company at Waukegan, Illinois, to kindling. When the storm subsided, the naked piling was left standing, unsightly and useless before the factory doors.

The factory manufactures outboard mo-



Removing piling with outboard-powered high-pressure pump

tors capable of producing from a fraction of a horsepower to more than 32 horsepower. The engineers commandeered a power head capable of producing about 10 horsepower and used this boat engine to remove the piling. Attached to a centrifugal pump, the motor threw a stream of water at high pressure for more than 50 feet.

A raft, the power head mounted in a boat, a length of hose, and iron pipe completed the equipment used by the crew of men to remove about 20 of the piles. The pipe was thrust into the bottom of the lake alongside the piling, and the thrust of the water at high pressure loosened the huge poles. They were then pulled out by the men on the raft and dragged to shore.

New Type of Rubber Blocks X Rays

RADIO fans who happen to be located near a hospital or any other place where an X-ray machine is operated, are painfully aware of the ease with which X rays penetrate ordinary walls. In order to insulate an X-ray apparatus, it has been necessary to line the walls of the room with heavy sheet lead. Now, however, rubber chemists have discovered that certain lead compounds can be incorporated with rubber to make an ideal shield for the vagrant X rays. The new material is known as Ray Rubber and has been successfully tried out in a hospital in New York City.

Ray Rubber contains a homogeneous lead compound which has passed all tests made by X-ray machine manufacturers. Dangerous X rays cannot penetrate Ray Rubber. It provides a good-looking surface easily kept clean, making the X-ray room attractive rather than dull and drab since the material is available in a variety of standard colors.

Ray Rubber replaces the old Holland barium brick, heavy and expensive because it had to be imported; barium mixed with plaster which cracked, permitting the rays to pass through, and lead, which requires expensive burners to perfect its joints. Ray Rubber has a peculiarly fashioned reverse curve edge which permits a small lap joint through which no X rays can pass.

It is easily applied with an approved type of cement to walls and floors, doing away with troublesome fastenings of various sorts. For the floors it may be applied either to concrete or wood. Edges of the flooring and joints are made impervious to ray penetration by application of Rayproof cement.

Ray Rubber is made in blocks 18 by 24 inches and 0.5 inch thick, which has an equivalent screening power against X rays of 0.125 inch of lead.—*A. E. B*

Blind Spots and Collisions

IT is an interesting fact that three important aeronautical publications, *Aviation* in the United States, *The Aeroplane* in England, and *L'Aéronautique* in France should discuss at about the same time the question of blind spots on the airplane and their effect in increasing the possibility of collisions.

In the early days of flying, when traffic was very slight, pushers with nacelles forward of the wings were quite common. An example of such design is the Farman F.40, which was quite famous during the World War. In this plane, both pilot and observer were seated so as to be practically clear of all obstructions to vision. The disadvantage of this type was the placing of the heavy engine behind the crew, and so it was gradually discarded. Yet from vision considerations, this type was well nigh perfect or at any rate far superior to the airplane of today.

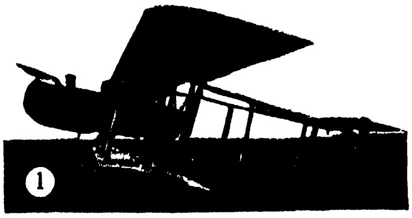
Monsieur Henri Bouché, Editor of *L'Aéronautique*, illustrates the collision dangers of the modern airplane in some graphic diagrams, which we reproduce in these columns. In one diagram is shown the "parasol" monoplane, that is, a monoplane with the wing placed at some height above the fuselage. The range of vision is indicated by the lines. When two parasol monoplanes meet they may readily strike head-on

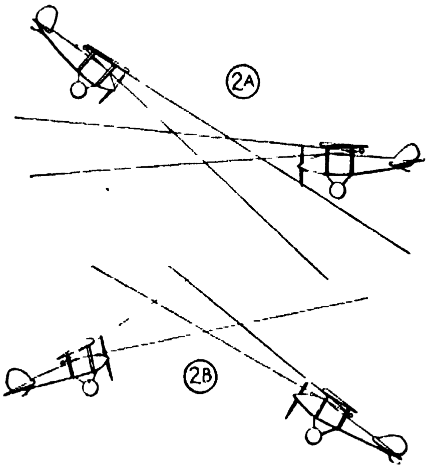
In another diagram, the upper machine, with enclosed cabin, may be struck by the parasol monoplane approaching it from below.

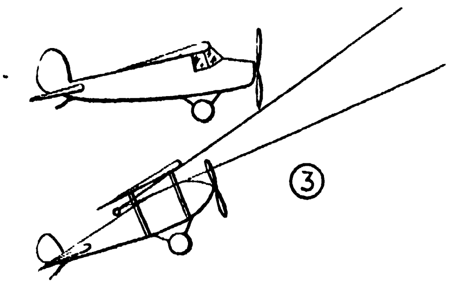
It is not difficult to imagine similar difficulties when machines are landing or taking off on a busy field.

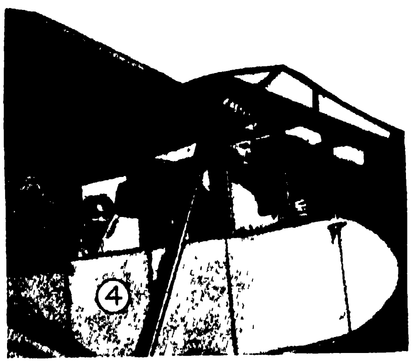
Two engineer-pilots, also writing in *L'Aéronautique*, suggest a number of remedies, some novel, some borrowed from the practice of other designers.

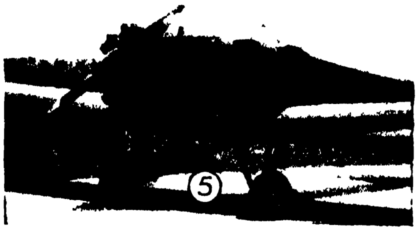
Suppose that the designer, for a variety of reasons, has decided to build a high-wing cabin monoplane. Then the pilot should be placed well forward, ahead of the wing, with the wing somewhere about the level of his eyes The entire cabin should be provided with non-shatterable glass—ahead, above, at the sides, and below far toward the rear. The Berliner-Joyce cabin

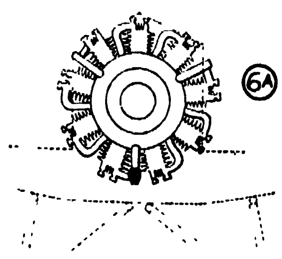


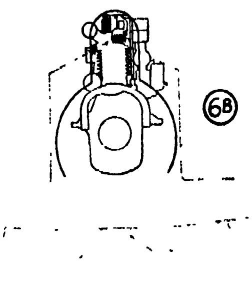


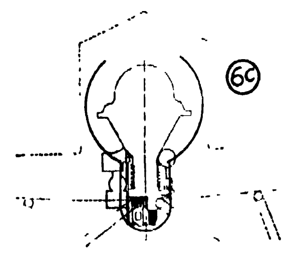


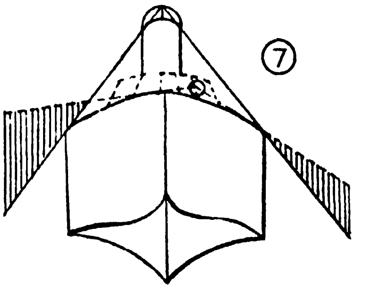








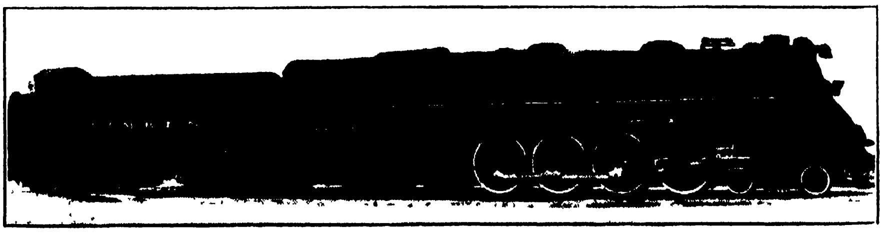




In the famous Farman war-time plane, *1*, the pusher nacelle made possible almost perfect vision. Parasol monoplanes, *2*, may collide head-on because of restricted area of sight. A parasol plane coming from below may get into difficulties as in *3*. The pilot's position in the Berliner-Joyce monoplane, *4*, affords an almost unobstructed view. The open cockpit, low-wing Aeromarine-Klemm monoplane is at *5*. A comparison of the obstructing qualities of engines is given in: *6A*, a radial; *6B*, a conventional in-line; and *6C*, an inverted in-line. A conning tower, *7*, has been suggested for flying boats

monoplane is an interesting illustration of this idea. Of course there is some sacrifice in efficiency because the line of fuselage and wing is broken, and this means increased drag.

A very promising design for commercial use is the low-wing monoplane, in which the pilot is placed either ahead of the wing or at its leading edge. Here the blind spots above and towards the rear disappear completely. The vision below is obstructed somewhat, but the imperfection of vision is far less than in the high-wing job.



A mobile rail laboratory for roller bearings

Even if the low-wing monoplane is employed, the vision may not be perfect ahead. Improvement is to be sought by narrowing down the fuselage ahead of the pilot. This depends greatly on the choice of engine. In the sketch, a low-wing airplane is depicted with a radial air-cooled engine in one case, a four cylinder in-line air-cooled engine in the second case and an inverted air-cooled engine in the third case. It is remarkable what an improvement the inverted engine makes possible in vision forward, because the fuselage ahead of the pilot may be made narrow.

Another step in the direction of perfect vision, advocated by designers not only in Europe, but also in the United States, is the re-employment of the pusher, low-wing monoplane with outriggers supporting the tail. In the pusher monoplane, even if the nacelle is an enclosed cabin, the vision is perfect.

Airplane design moves in cycles and it would not be surprising to see the practice of 15 or more years ago revived in our most modern craft. The Northrop "flying wing" is a step in this direction.

Even in the very large flying boat the question of pilot's vision is not to be escaped. A pilot sitting fairly low in a wide flying-boat hull, may have excellent vision on one side and be seriously handicapped on the other. Is a species of conning tower worth while in spite of the extra head resistance involved?—*A. K.*

Roller-Bearing Demonstration Locomotive

NOT so long ago the prediction was made, during the course of a speech before a group of railroad men, that trains would soon be attaining a speed of 110 miles an hour This probably seemed a rather sweeping statement, especially with regard to the time element implied. But, the appearance of a locomotive with a rated speed of 85 miles an hour gives the impression that fulfilment is not so very far away after all.

The history of this locomotive is short, but interesting; it was built by The Timken Roller Bearing Company, primarily as a means of obtaining complete and accurate data on the practicability and performance of tapered roller bearings in railroad service. The company plans to lend the locomotive to various railroads throughout the country for operation in their regular passenger and freight service for certain periods. During its stay on the different lines its performance will be closely observed, and a careful record will be kept of the expense necessary to maintain it. Thus a fund of information covering both the economic and practical phases of the bearing question will be accumulated.

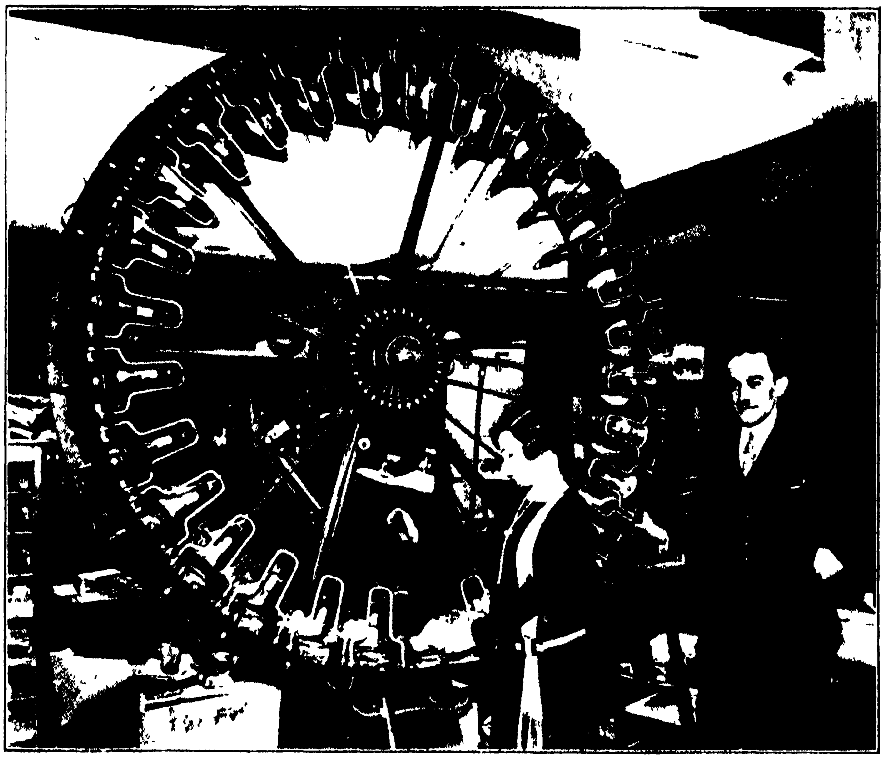
The very fact that it is intended for a mobile laboratory has led to the incorporation of features in design and construction that have resulted in making it something altogether unique in railroad history. Since it is to be used on both passenger and freight service, interchangeably, it had to combine the speed characteristics of a passenger locomotive with the pulling power of a modern high-speed freight locomotive. As different railroads have different limitations as to permissible weight on the drivers, or axle load limitations, provision had to be made for altering the weight to meet these requirements. And, in addition to the tapered roller bearings, it offered an opportunity to experiment with various alloy steels as material for parts ordinarily subject to excessive wear or strain.

The locomotive was built by the American Locomotive Company, according to specifications furnished by the Timken Roller Bearing Company. It is of the 4-8-4 type, is 102 feet long over all, and has a total weight of approximately 710,000 pounds. The engine proper weighs 417,000 pounds. It is built to operate at two steam pressures, 250 pounds and 235 pounds respectively, and is provided with a duplex weight distribution so that the weight on the drivers may be either 264,000 or 246,000 pounds. The first is used at 250 pounds steam pressure to give a normal tractive effort of 63,700 pounds which is increased by the booster to 76,500 pounds maximum at starting. At 235 pounds pressure, the normal tractive effort is 59,900 pounds, and the maximum at starting is 71,900. This arrangement takes care of the varying limitations on different railroads. The specifications call for a maximum speed of 85 miles per hour, with a dynamic augment within the limitations usually specified for similar locomotives at diameter speeds. Actually, the construction is such that this speed can be exceeded without passing the limitations as to dynamic augment.

Heredity

IT has, in general, been taken for granted that human heredity is fixed and that new characters can be developed only by accident, sports, or by the passing of thousands of years. Recently Professor Erwin Baur discussed in Germany the possibility of modifying characters by the use of chemical and physical stimulation. Research carried out on flies and on plants has shown that it is possible to bring about changes through modification of some part of the chromosomes.

American investigators found that the action of radium would change the nucleus of the cell. Baur produced changes in plants by modifying the structure not only of the nucleus but also of the protoplasm of the cell. When plants were subjected to immersion in hot or cold solutions or to the effects of various drugs, such as chloral, ether, or alcohol, they continued to develop and propagate and the succeeding genera-



Greatly increased production is promised by this ingenious shoe-making machine recently developed in England. With it, it is stated, it is possible to turn out 600 completely finished pairs of shoes in eight working hours

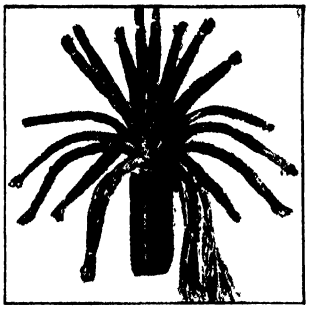
In *fair weather or foul . . .*

Western Electric backs up your telephone service

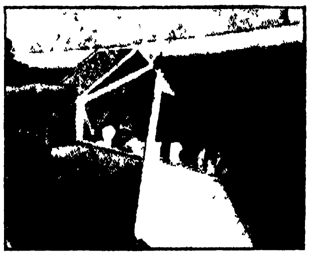
In foul weather, just as in fair, Western Electric backs up the Bell System with all the apparatus and supplies needed to restore, maintain or expand your telephone service.

This Company manufactures telephone equipment of every sort, with a skill acquired through 50 years' experience. At 32 warehouses it holds great reserves of telephone material available for shipment day or night. It delivers and installs the apparatus when and where needed.

The large scale manufacture of standardized equipment, too, is an economy. So is the concentrated purchasing—a responsibility that Western Electric undertakes for the telephone companies of the Bell System. All in all, here is a work of mass production, purchasing and distribution which for size and complexity has no parallel in industry.



1818 conversations at one time can be carried on through this new type cable. It contains 3636 insulated wires within a diameter of 2⅝ ins.



The flying telephone laboratory in which Western Electric airplane telephone equipment has been developed by the Bell Laboratories. Provision for communication between ground and plane marks a great forward step in flying.

One of the 18 materials in your telephone is rubber from the plantations of Sumatra. Western Electric goes to market in every corner of the world.

Western Electric

THE MAKERS OF
BELL TELEPHONES

tion did not show any change. However, in the third generation dwarfism, degenerations, and bent leaves and blossoms, appeared Thus it is obvious that factors affecting the human cell may actually have their influence not only to the third generation but primarily in the third generation.

Before a German society for the advancement of science, Prof. Ernst Rüdin announced the fact that several of the children of people with hereditary chorea developed chorea at an early age. Among the children of people with manic-depressive insanity, 33 percent of the children are affected; among the children of epileptics, 10 percent are affected, and among the children of parents with hysteria, 13 percent are affected. The mental health of the child is clearly the reflection of the mental health of its parents. Notwithstanding the fact that this inheritance is clearly established, persons continue to marry without any attempt at investigation of their antecedents from the mental point of view and without any realization that the offspring are bound to reveal the effects of the mentally weak heredity.—*M.F.*

A Plane Price War

THE Stinson Aircraft Corporation, recently acquired by the Cord automobile interests, threw a bombshell into aviation circles, at the time of the St. Louis show, by announcing some startling price cuts. Our photograph shows the Stinson four-place cabin plane, powered with a 210 horsepower Lycoming radial air-cooled engine The plane is of neat though conventional design, and has excellent performance and flying characteristics.

The airplane builders are now rivaling the automobile builders in the completeness and luxury of equipment. The Stinson has an electric self-starter, adjustable metal propeller, wheel and emergency parking brakes, cabin heaters, hydraulic and spring shock absorbers, broadcloth upholstery, shatter-proof glass, rubber-insulated motor mount, gasoline gages, dual wheel control, adjustable pilot seats, balloon tail wheel, navigation lights, and smoking sets.

Last year planes of this type were selling at about 9000 dollars. Now the Stinson company announces a price of 5775 dollars. In some aviation circles the opinion is held that the Stinson Company will lose money rapidly. Others hold that increased sales and better production will justify the reduction in price and that eventually a plane of high finish and performance will sell to the private owner at prices no higher than those of a really first-class automobile. *A.K.*

A four-place Stinson Junior cabin plane that sells now for only 5775 dollars, a price far lower, for this particular type of plane, than ever before quoted

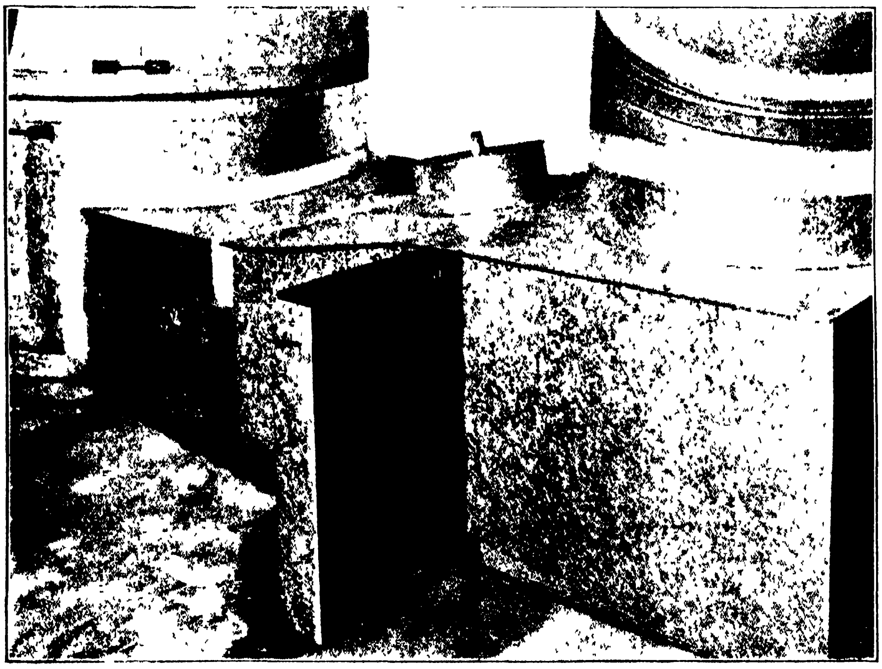
Fever and Radio Waves

FEVER is the reaction of the body to disease. Heat developed in the body helps to control germ activity. In the attack on general paralysis by the malaria injection method, one of the results of the injection is to produce fever. In the treatment of other conditions like general paralysis the production of fever may be an important factor. Fever in the human being follows the injection of any foreign protein substance. When such injections are made, their actions are sometimes severe.

Attempts have been made by the workers in the Research Laboratories of the General Electric Company to develop some system of raising the temperature of the body without injecting anything into the body. Drs. C. M. Carpenter and A. B. Page have been developing a method of raising the temperature by the use of short wavelengths. In this method the energy is concentrated between two condenser plates made of aluminum covered with hard rubber to prevent arcing should the patient or any attendant come in contact with the plates. The person whose temperature is to be raised is suspended on cotton tapes stretched across a wooden frame and surrounded with Celotex so that there is a fairly tight air chamber around the body. The plates are placed at each side of the Celotex box and the waves oscillate through the body from one side to the other.

It has been possible to raise the temperature of a man five degrees in one hour with this apparatus. Indeed, it would be possible to raise the temperature much higher than 104 to 105 degrees, but this has not been done because of the possible danger.

When the temperature of the body is raised rapidly by such a device, the person begins to have a fast pulse and to breathe more rapidly. Usually the blood pressure falls. In some instances high temperatures were maintained for one hour without apparent distress or fatigue to the patient. It is believed that the development of the heat in the body is due to the resistance made by the body to the conduction of the current. The evidence thus far available from studies in some 25 human beings and of many laboratory animals indicates that the heat within the body makes it less favorable for the multiplication of germs and that the increased rate of the various chemical processes in the body aids the resistance to disease and infectious agents. —*M.F.*



Filtered, forced warm air for heating and ventilation is now possible with this combination of filter, shown here partly withdrawn from its housing, and electrically driven fan. The fan draws cold air through the filter for cleaning, and delivers it to an ordinary hot-air furnace for heating

Welding Copper Made Easy

UNTIL recent years it was considered that the satisfactory welding of copper was impossible. The high thermal conductivity of the metal gave rise to grave practical difficulties, and even if these were overcome it was found that the copper became brittle by the action of the gases in the acetylene flame. As the result of recent research work, however, a process for welding copper has now been evolved which renders the operation simple and safe, provided the correct materials are used.

A demonstration of this welding was carried out recently at Swansea, England. At this demonstration copper pipes were welded together without difficulty and the joint subjected to severe flattening and bending tests, the results of which proved conclusively that the weld would withstand conditions of service as satisfactorily as the pipe itself. Sheets of copper were also joined together by the welding process, and it was shown that these would withstand a considerable amount of work and stretching; in fact, as much as the solid copper itself could be expected to withstand. The welding of varnish-pot seams was also demonstrated, a process which eliminated a great deal of troublesome riveting. It was observed that the welding operator worked quickly and as easily as if he were merely brazing the pieces together, and after the weld had been made and trimmed it was difficult to see where the joint occurred, while it had a tensile strength equal to that of rolled copper.

The demonstration proved that the difficulties previously associated with the welding of copper had been overcome, and it is certain that there is a wide field in industry for the application of the process. Riveting will be largely eliminated, and vessels which previously had to be forged out of solid copper—a very expensive procedure—can now be built up by welding sections together. All this has been achieved by means of slight modifications in the technique of welding ferrous metals, by the use of copper alloy filler rod and flux of the appropriate type

The copper that has been developed for welding purposes is not attacked by the gases of the acetylene flame, and it is essential to use this copper if the weld is to be perfectly satisfactory. The copper is a modification of the tough pitch variety, supplied at the same price, but not inferior to it in any way; in fact, it might be expected to give better service generally. The filler rod, again, is of specially modified copper, which is very fluid when molten, and so runs well into the joint, leaving no air locks or gaps. It is essential to use this filler rod in order to obtain a homogeneous weld. The flux is used in order to hinder the formation of scale on the red hot copper as the scale prevents good metallic contact, and hence a solid joint, from being obtained.

Using these materials, it was demonstrated that with an hour's practice a welder could acquire the technique of copper welding and produce sound joints as easily as he could with ferrous materials. —*A. E. B.*

Regulating Air Transport Services

IN the continued depression of the aviation industry, there is one bright spot—the continued and rapid growth of the transport service; mail, passenger, and (to some extent) express.

We believe that the new regulations of the Department of Commerce regarding transport services will help rather than hinder this growth. These regulations provide that before scheduled operation of passenger air transport is established, a Certificate of Authority must be obtained from the Secretary of Commerce. To secure and retain such a certificate the service must provide satisfactory aircraft and equipment, an adequate number of qualified airmen, a high degree of maintenance efficiency, good airways and navigation facilities, and a first-class ground organization.

Nothing is so well calculated to inspire the traveling public with confidence as regulations of this character, well and diligently administered.—*A. K.*

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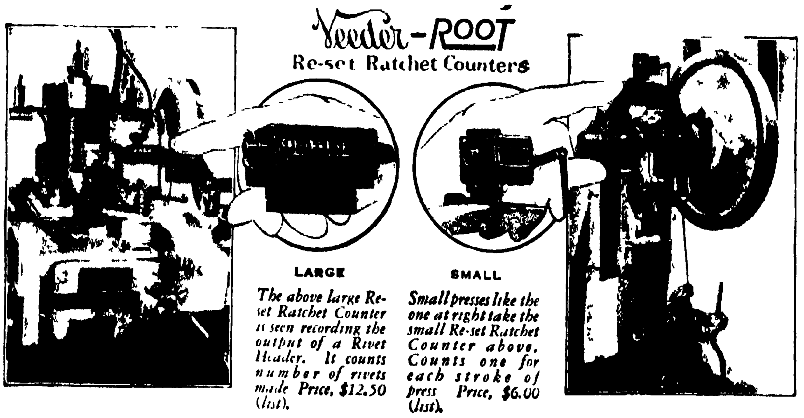

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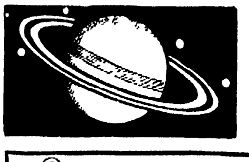

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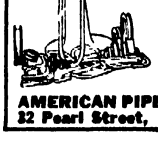

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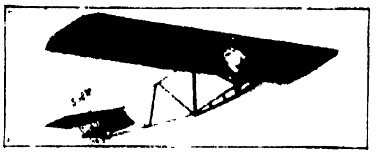

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The Amateur Astronomer

Conducted by ALBERT G. INGALLS

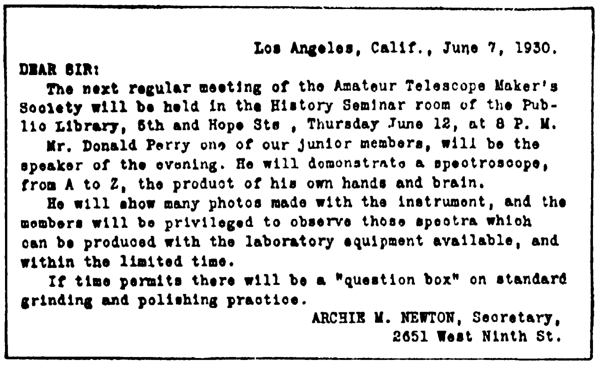
WORD comes out of the wilds of Vermont that the fifth annual "get-together" of amateur telescope makers will be held on August 15, 16, 17 at the usual place, "Stellafane," near Springfield. Let this notice serve as sufficient excuse for all and sundry to come. John Pierce and the other members of the "Telescope Makers of Springfield" expect later to send out individual postcard announcements to those in the east, but do not let failure to receive one keep you away, it might be merely a mistake. "The big day," Pierce writes, "is Saturday, the 16th, with Porter, Redfield, Marshall and other illustrious people strutting their stuff." We do not know what profound secrets these entertainers have up their sleeve Mr. Redfield's specialties are cornbread and poetry.

Bob Burns. He saved 80 "bob"

Last year so many attended this informal confab of amateur telescope makers and astronomers that it was a question whether to rent a circus tent next time. People came from all over the east, and some from greater distances, to commune with other enthusiastic telescope fans There is a small hotel in Springfield, also very limited "quarters" (for men) at "Stellafane" A good many come in their cars, bringing their families and tents. There is all sorts of room to camp, and a good spring of water is nearby Leave your dress suits in mothballs, as this is not a "high hat" affair but just a friendly, comfortable gathering of "folks" If you have made a telescope or invented any kind of optical dingbat of which you are unashamed, bring it along and give the other fans a chance to knock it. If you wish to make any special arrangements write to the Secretary of the "Telescope Makers of Springfield," Oscar S Marshall, 135 Wall Street, Springfield, Vermont.

WHEN the hot months come people usually let up their efforts in telescope making; they had rather be out of doors than working in the cellar workshop. About September the orders for the instruction book "Amateur Telescope Making" always begin to come in thick and fast, and then we know the game is on again. However, to judge from the postcard announcement which is reproduced on this page, telescope making activities never wane, even in hot weather, in lively Los Angeles. Fragments of information reach us from time to time about the various activities of the Amateur Telescope Maker's Society of Los Angeles, the latest being that they have gone in heavily for refractor making. The seed that was dropped in that city four years ago is growing in fact, already has grown into a thriving tree. We wish the amateurs of "L. A." would send in accounts of their doings, with photographs of the jobs done, for publication.

Some of the telescopes made by amateurs have been pretty elaborate affairs and some are not so elaborate. However, we publish them all because we do not wish merely to feature the finer ones. A worker who builds a small instrument may lack facilities for making a large one, he may not happen to have had special training in machine work, he may not be rolling in wealth, but he derives as much fun from making it as the fellow who puts together a big one. One thing, however, is that we have found that the work is not suited to boys. Very few have made good at it, and those, we suspect, were unusually bright lads with an aptitude for mechanical work and for thinking.


Los Angeles, Calif., June 7, 1930.

DEAR SIR:

The next regular meeting of the Amateur Telescope Maker's Society will be held in the History Seminar room of the Public Library, 5th and Hope Sts , Thursday June 12, at 8 P. M.

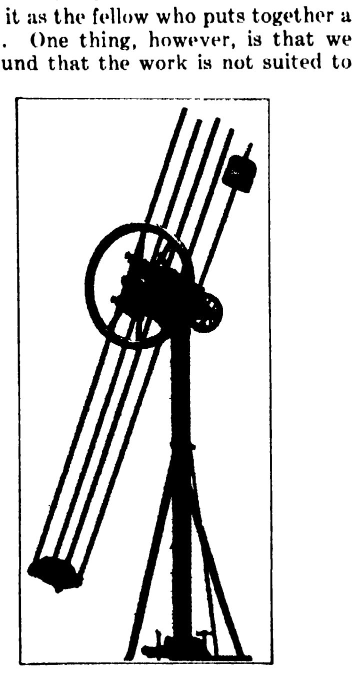
Mr. Donald Perry one of our junior members, will be the speaker of the evening. He will demonstrate a spectroscope, from A to Z, the product of his own hands and brain.

He will show many photos made with the instrument, and the members will be privileged to observe those spectra which can be produced with the laboratory equipment available, and within the limited time.

If time permits there will be a "question box" on standard grinding and polishing practice.

ARCHIE M. NEWTON, Secretary,
2651 West Ninth St.

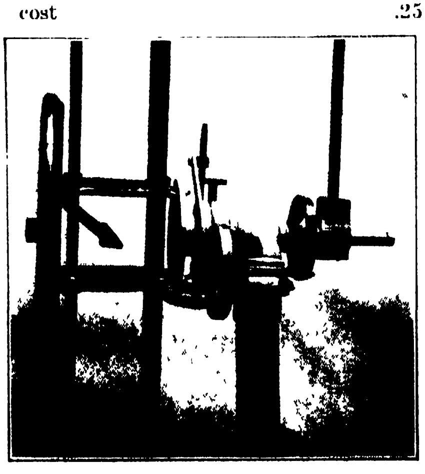
Thriving amateur activities in "L. A."


***Above and at right,* "Friday" Angier's unique design**

JUST how inexpensively a telescope can be made never has been settled, but Bob Burns, of 326 Courtland N. E., Atlanta, Georgia, has shaved a big chunk off the average cost of a six-inch reflector. The materials for a six-inch telescope which will magnify from 50 to 200 diameters usually cost about 25 dollars. The initial outlay is ten dollars for a prepared package containing the glass disks, abrasives, and pitch. With these the mirror is made and then after some time the eyepiece and diagonal prism, each at six dollars, are obtained The average amateur worker can be trusted to pick up the remaining parts, chiefly secondhand, for little or no more than the remaining three dollars. Often we are asked whether there is a way to make a telescope still more cheaply than this. There is. If one can pick up a microscope eyepiece this will save six dollars. Other savings are possible in some cases, depending on the worker's resourcefulness.

A four-inch, instead of a six-inch mirror, provided the main solution of the cost problem, in the case of Mr. Burns, who made a telescope at a total cost of $5 35. We asked Mr. Burns to tell the amateurs how he did it. Here is what he reports.

The four-inch glass disks were cut from two pieces of one quarter inch broken windshield glass which I procured for the asking at an auto junk dealer. Cost	$ .00
Cutting and grinding the edges of these disks, at an automobile glass service station, was	.25
The American Optical Company furnished me three grades of emery (No. 60, 120, 302) and the rouge for	.65
Silver nitrate, one quarter ounce, cost	.25



I used household ammonia and formaldehyde to reduce the silver nitrate, when silvering the mirror. Cost to me	.00
A wood turning shop made the wooden mirror cell for	.50
The 24-inch tube is made of polished sheet zinc, and cost	.90
For my diagonal I used a piece of one quarter inch plate glass of oblong shape, 1¼ by ¾ inches, corners rounded, the supports being soldered to the inside of the tube. The cost of this was	.00
The eyepiece was taken from a "pencil" microscope which cost	1.00
Brass tubes for eyepiece (plumber's shop)	.15
Lumber for tripod, cut to size	1.25
Bolts for tripod	.20
Lacquer and brush for painting tripod and inside of tube	.20
The total expenditure came to ..	$5.35

I polished my mirror by gluing the crown of an old felt hat to my tool and polishing on this pad. It finished out in about 1½ hours. I made no attempt to change the curve from a sphere to a parabola.

With the three quarter inch, double-convex eye lens the telescope gives about 50 to 60 diameters magnification. The innumerable craters on the moon are very interesting

PHIL E. CHURCH, 104 East LaRue, Streator, Illinois, sends in a few pictures of an unusual telescope. He says "Three of us did the work, but 'Friday' Angier conceived and built the mounting. The steering wheel is for rapid control in directing the telescope but there are slow-motion screws and these are turned by means of sewing machine flywheels. The three of us, 'Friday,' Herbert Prafcke, and I, are greatly satisfied with this arrangement and we invite comment from other amateurs." Are there any who want to break a lance with these three musketeers?

THE following hint is from the April number of the *Journal of the British Astronomical Association* and was contributed by Walter E. T. Hartley, 11 Manor Road, Edgbaston, Brimingham, England. Birmingham is one of the great industrial centers of Great Britain and much bitumonious coal, with its inevitable content of sulfur which quickly tarnishes silver, is used. He says, "I keep two layers of cotton wool in the cover, and while observing put the cover in front of the fire—this ensures a dry film, but I have now between the wool and the mirror two thicknesses of blotting paper which have been soaked in a strong solution of lead acetate and then dried. As a result my last silvering was done in 1923, and the mirror is only now beginning to show signs of tarnish." Try it, someone, and see how it works, for soft coal sulfur in America is the same as soft coal sulfur in England.

HERE is an interesting hint. Harold A. Lower, 1032 Pennsylvania Avenue, San Diego, California, who is always trying out something new in amateur optics, writes: "I discovered a new use for a microscope the other day. The mechanical stage makes an excellent arrangement for controlling the knife-edge when making the Foucault test. Just attach the razor blade to the mechanical stage by means of a small D-clamp, and it works as if made to order."

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Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Longleaf Pine Primer (Farmer's Bulletin No. 1486, U. S. Department of Agriculture) by W. R. Mattoon, describes the growing of longleaf pine as a crop, pine timber being so scarce. The pamphlet is fully illustrated *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

Porcupine Control in the Western States (Leaflet No 60, U. S Department of Agriculture) by Ira N. Gabrielson and E E Horn deals with a pest, for they girdle trees and injure forests. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

Properties of Soils which Influence Soil Erosion (Technical Bulletin No. 178, U S. Department of Agriculture) by H. E. Middleton gives valuable light on an old problem *Superintendent of Documents Washington, D. C 5 cents (coin).*

The Coffee Industry in Brazil (Trade Promotion Service No. 92, U S. Department of Commerce). *Superintendent of Documents.—20 cents (coin or money order).*

Bismuth (Circular of the Bureau of Standards, No 382, U S Department of Commerce) gives very full information on the metal and its alloys. *Superintendent of Documents, Washington, D. C. 10 cents (coin).*

Geology and Oil Resources Along the Southern Border of San Joaquin Valley. (Bulletin 812 D, Geological Survey, Department of the Interior) by H. W. Hoots. *Superintendent of Documents, Washington, D. C 50 cents (money order).*

Breeding Tobacco for Resistance to Thielavia Root Rot (Technical Bulletin No. 175, U. S. Department of Agriculture), by James Johnson, is a study of a common and important disease of tobacco. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

New Brunswick, Canada, by L. O. Thomas, describes the industries, agricultures, natural resources, and development of New Brunswick. *Address the Director, National Development Bureau, Department of the Interior, Ottawa, Canada.—Gratis.*

German Chemical Developments in 1929 (Trade Information Bulletin No 690, U. S. Department of Commerce) reports the important events in the industry during 1929. *Superintendent of Documents, Washington, D. C. —10 cents (coin).*

The North West Territories 1930 is the title of an attractively illustrated handbook of 137 pages. A concise compendium of general facts relating to Northern Canada, it is accompanied by a beautiful map. *Address the Director, North West Territories and Yukon Branch, Department of the Interior, Ottawa, Canada.—Gratis.*

Tides and Currents in Chesapeake Bay and Tributaries (Special Publication No. 162, Coast and Geodetic Survey, Department of Commerce) by F. J. Haight, H. E Finnegan, and G. L. Anderson, contains many folded maps. *Superintendent of Documents, Washington, D. C. —65 cents (money order)*

The Marketing of Nickel (Trade Information Bulletin No. 685, U S. Department of Commerce) by J. W. Furness tells what nickel is, where it is produced, for what it is used, and where it is marketed. *Superintendent of Documents, Washington, D C—10 cents (coin).*

Tin in 1928 (Excerpt pages 321-346 of the Mineral Resources of the United States, Bureau of Mines, U. S. Department of Commerce) by Charles White Merrill. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

Preliminary Reports of the Aerial Mineral Exploration of Northern Canada gives an interesting account of investigation of large areas with the aid of airplanes. *Address the Director, North West Territories and Yukon Branch, Department of the Interior, Ottawa, Canada.—Gratis*

Water-Power Resources of the Umpqua River and its Tributaries, Oregon (Water Supply Paper 636-F, Geological Survey, Department of the Interior) by Benjamin E. Jones and Harold T Stearns. *Superintendent of Documents, Washington, D. C.—40 cents (money order).*

Geology and Coal Resources of the Meeker Quadrangle, Moffat, and Rio Blanco Counties, Colorado (Geological Survey Bulletin 812-C, Department of the Interior) by E. T. Hancock and J. B. Eby. *Superintendent of Documents, Washington, D. C —30 cents (money order).*

Ultra-Violet Reflecting Power of Aluminum and Several Other Metals (Bureau of Standards Reprints, No. R.P. 141) by W. W. Coblentz and R. Stair. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

How to Build Home Radiovision Equipment explains the technique of radiovision reception and what is required by way of equipment, and then goes on to describe the construction of a practical radiovisor made from a kit of parts now on the market. *Jenkins Television Corporation, 370 Claremont Ave., Jersey City, N. J.—Gratis.*

An Electrical Method for the Determination of the Dew-Point of Flue Gases (Circular No. 20. Engineering Experiment Station, University of Illinois) by *Henry Fraser Johnstone, University of Illinois, Urbana, Ill.—15 cents.*

Standards Year Book 1930 (Miscellaneous Publications No. M 106) is a cloth-bound book of 301 pages. *Superintendent of Documents, Washington, D C—75 cents (money order).*

Nation Building and Beyond (The Richard Cobden Lecture given at the Royal Society of Arts, London, May 7, 1930) by Nicholas Murray Butler is a very famous lecture which made a great sensation both here and abroad. *Carnegie Endowment for International Peace, 405 W. 117th St., New York City, N. Y.—Gratis.*

The Kyoto Conference of the Institute of Pacific Relations (No. 260 of International Conciliation, May, 1930) by Chester H. Rowell. *Carnegie Endowment for International Peace, 44 Portland St., Worcester, Mass. 5 cents.*

Weights and Measures References (Miscellaneous Publications No. M 103) including an index to the reports of the National Conference on Weights and Measures, from the first to the twenty-first inclusive. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

The Commercial Standards Service and its Value to Business (Commercial Standard CSo-30, Bureau of Standards, U. S. Department of Commerce) gives the whole idea in a nutshell and is an exceedingly valuable little pamphlet. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

Trailside Conversations. Parts One and Two (New School Series Number Four) by Wm. H. Carr. Describes the nature trails and trailside museum at Bear Mountain, New York. It is beautifully illustrated. *American Museum of Natural History, 77th Street and Central Park West, New York City.—20 cents.*

Our Point of View

Navies and World Problems

(*Continued from page 93*)

tration and the delegation had frankly said it was the best treaty obtainable under the circumstances. President Hoover was in no way responsible for our present inferior position in cruisers and submarines, nor for the unwillingness of Japan to reduce her tonnage *already built* to the 5 to 3 ratio.

The country is under obligation to Senators Hale, Johnson, and Robinson of Indiana, for the severe scrutiny they have given the draft of the treaty. They uncovered an ambiguity in the wording about cruiser replacement that might have caused serious misunderstanding; this was cleared up by an exchange of notes between the contracting parties. More important still, the answers to their persistent questions have more fully informed the public about the effects of the treaty.

The group of admirals led by Rear Admiral Hilary P. Jones, who analyzed the treaty, who showed the extreme concessions made to Japan, and who bore strong testimony to the value of 8-inch gun cruisers, deserve well of their countrymen. Called by the Senate committees, they were obliged to bear true witness to their beliefs; and though we support the treaty, we have no doubt of their sincerity or sound judgment. We believe with them, that 8-inch gun cruisers would better serve our purpose; but can't believe that 6-inch gun cruisers will not serve us well in any war that we might be drawn into. Important political factors have to be considered as well as naval, and with those in mind, we reluctantly conclude that our best hope for a navy within the next five years is to ratify the treaty and commence to build ships, instead of indulging in more conferences.

INSTEAD of frightening tax payers by talking about an 800,000,000-dollar program that will be spread over 8 to 10 years, the Administration should explain that the appropriation for this program will be about 90,000,000 dollars a year or about 75 cents per capita annually, a paltry sum for the protection it affords our country and its sea-borne trade.

A disquieting fact disclosed by the Senate testimony is the scant heed paid by the delegation to their naval advisers—apparently even Admiral Pratt was consulted only after the decisions were made by the delegation. There is a current opinion in the United States that in the past too little attention has been paid by the State Department to Army or Navy advice. The results of this rather disdainful attitude of the State Department is expressed loosely by the phrase heard in so many places "We never lost a war, and never won a conference." The country believed that Mr. Hoover, himself an expert engineer, would insist that the naval experts he attached to the delegation be consulted; Mr. Stimson almost airily relegated them to the rear. Democratic government is essentially a government by amateurs. Americans would not have it otherwise, but they believe Admiral Jones is more apt to be right on a naval problem than Secretary Stimson, and we think we would have had a better treaty if Stimson, Dawes, and Reed had not been a little over-eager to play it alone.

Fortunately, the life of this treaty is less than six years; then the whole question of ratios will be subject to reconsideration. If our people really want a navy and are willing to pay the small premium required for their naval insurance, they can build up to the treaty limits by 1936, and enter the next conference in a position to insist that our naval necessities be recognized. If we do not want a navy badly enough to pay for it, we should cease demanding that more prudent powers stop their building programs simply because we are too niggardly to build a navy that we all know we need, and need badly.

We should realize that, now having outbuilt us, Japan is unwilling to make the concessions that we made in 1922, when our ship-building program was about to give us sea supremacy. If our people appreciate the significance of this fact, and lose some of their naive belief in the altruism of other States, eventually they will be well compensated for the temporary disadvantage of the treaty.

ITALY and France are no nearer agreement than they were in London and it is quite possible that England may have to invoke the "safety clause" which allows an increase in her cruiser strength in the event that Italy and France enlarge their naval programs. We would be permitted the same increase granted England. Much more alarming than an increase in the Latin navies is the apparently irreconciliable rivalries of these two Mediterranean powers. Observers, who are usually well informed, speak in measured terms of the possibility of war between these two neighbors Such a conflict would be bound to spread to other European States, and no one could predict its limits.

This is an uneasy period for Premier MacDonald. The unrest in India continues unabated and if this passive resistance extends as urged by Gandhi's successors, to a refusal by the great mass of Indians to pay taxes, the task of the Viceroy, Lord Irwin, will be difficult indeed. To add to MacDonald's troubles with Egypt and India, the small but strategically important island of Malta took occasion to flare up, and it is reported that considerable discontent with British rule exists within its limited confines. Unquestionably both India and Egypt have benefited by English rule, it is certain that neither could maintain law and order at home or resist foreign States unless supported by Great Britain, and yet, led by sincere but uninformed reformers, they continue their agitation for independence without any let-up.

It is one of life's fine ironies that the Labor Party which, in opposition, is fond of declaiming against imperialism, is face-to-face with one of the great problems of empire. Gladstone, England's great Liberal leader, often accused of being a "little Englander", found himself in a similar quandary on more than one occasion; and Sir Henry Campbell-Bannerman, another great Liberal, faced and solved the problem of the Union of South Africa after the Boer War. And it is not unlikely that a Labor Premier will find a solution to Great Britain's imperial problems. Needless to say, the action of the Labor cabinet in dealing with India will be no less firm than the Conservative.

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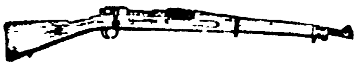

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OUR previous message to readers of these pages has been accepted so spontaneously by many book seekers, that we wish again to state, for any who did not notice the previous offer, that if you want to know what literature is available on any subject you are studying or any hobby you are pursuing, write to L. S. Treadwell, the editor who is responsible for this department and every attention will be given your request. Should there be nothing available we will be frank to tell you or advise as to the possibility of advertising for second-hand copies. Let us try to help you solve your problems.

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MATTER AND RADIATION—*By John Buckingham, Asst. Director of Scientific Research, The Admiralty*

A PECULIAR book, exhibiting a well-known English trait—it wanders casually over a large field touching with interest on this and that but without covering anything very amply. Yet the present reviewer found it so interesting that every word was read. Of the five chapters (90 pages) three are on electric waves, atomic physics, and radiation, the other two (40 pages) being on infra-red rays and their use in the detection of invisible objects, in secret signaling, fog penetration, self-steering torpedoes, navigation and so on—most fascinating things, every one—but since the author treats them with so much interest and lucidness, it is a pity that only a half portion of each could be served up. A full-sized book giving details on the same application of the infra-red if written by this author, should make reading which would defer the bed hour, for he has an evident flair for making simple things seem as simple as they really are. $3.20 postpaid—*A. G. I.*

THE ALUMINUM INDUSTRY—*By Junius D. Edwards, Asst. Dir. Research, Francis C. Frary, Dir. Research, and Zay Jeffries, Metallurgist, Aluminum Company of America.*

VOLUME I covers the history of the discovery of aluminum and the development of the industry, the ores of aluminum and their mining and refining for the production of pure alumina, and closes with a discussion of the production of metallic aluminum. Volume II gives the reader a broad view of the various processes by which aluminum is fabricated and discusses also its properties and uses. Two volumes (not sold separately), $12.50 postpaid.

THE NEW EVOLUTION—ZOOGENESIS—*By Austin H. Clark, U. S. National Museum*

IT has been said by some that Dr. Clark's new theory of organic evolution will take rank with Darwin's original theory as set forth in 1859 in "The Origin of Species." Darwin's great book created an immediate furor and the first edition was snapped up in next to no time, and first editions are today rare and highly valuable. What effect Dr. Clark's theory will have on biologic thought no one now knows but it seems certain to provoke a great deal of argument and controversy among men of science. The present volume sets forth the theory in detail and in language comprehensible to the reader of average schooling. Since it is likely to be the center of a major controversy, persons having interest in scientific events are advised to post up on it in advance and be in a position to comprehend the arguments. $3.20 postpaid—*A. G. I.*

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THE MATERIALS OF LIFE *By T. R. Parsons, M.A., B.Sc.*

A "DEBUNKED" presentation of biochemistry, for the chemistry of the human body is certainly a pin on which loose statements have been hung from time immemorial. "An apple a day" does not keep the doctor away. One orange contains more vitamins than a basket of apples. Light treatments and backless bathing are popular but many of us will be surprised to learn that the effect of ultra-violet rays is similar to that of cod-liver oil. The book gives sensible as well as accurate accounts of such things as gland secretions; vitamins; the cycle of nature; food energy; the living fire; wear and tear; blood and iron; starch, sugar, and fat; digestion and indigestion, et cetera. The author eschews horrifying formulas in which those who deal with such matters professionally are wont to encyst their ideas and writes in a language which all can understand. $3.20 postpaid—*A. A. H.*

PRIMITIVE METHODS OF WORKING STONE —*By Alonzo W. Pond, Logan Museum*

THIS most fascinating book is based on the flint-flaking and artifact-making experiments and activities of Mr. Halvor L. Skavlem, mentioned on page 88 of the present number. It describes Mr. Skavlem's actual technique; therefore it is, as the author intended, a practical instruction book: "Any student who will take the trouble to read the foregoing," he says, "will be able to apply the principles as has Mr. Skavlem and like him will, with a little practice, be able to make arrowheads and other chipped instruments." The book, though paper bound, contains 113 large pages, is handsomely produced and there are 64 fine half-tone plates. It is suggested that would-be purchasers obtain it direct from The Logan Museum, Beloit College, Beloit, Wisconsin. $1.15 postpaid *A. G. I.*

MY LIFE *By Leon Trotsky*

MEMOIRS of the exile Trotsky ought to be interesting when we consider the enormous power once wielded by himself and Lenin. The whirligig of fate, however, has been exceedingly swift in the case of Trotsky who was sent into exile by the present Soviet government in January, 1928, and he writes his book from Constantinople. Trotsky makes note of his arrival in New York as follows: "*Sunday January 18 (1917):* We are nearing New York. At three o'clock in the morning. Everybody wakes up. We have stopped. It is dark. Cold. Wind. Rain. On land, a wet mountain of buildings. The New World!" He stayed in New York about two months and contrary to many stories his only occupation or profession was that of a revolutionary socialist. He rented an apartment for 18 dollars a month and the colored janitor ran off with three months' rent. It is by such sidelights that we enjoy a book of this kind. In attempting to return to Russia via Norway he was taken off the steamer at Halifax with his family, and placed in a detention camp, but was finally released and allowed to continue his journey to Petrograd—a journey fraught with so much history. The theme of his rise to power and his eclipse is a very long story which you will have to read for yourself. His life was weird and fantastic. $5.20 postpaid—*A. A. H.*

SLEEP *By Laird and Muller, Colgate Psychological Laboratory*

THE many thousands who have taken keen interest in Professor Donald A. Laird's articles, published in the SCIENTIFIC AMERICAN during the past year or two, will find in this new book the substance of about 18 more equally interesting articles, all of which center around that rather familiar activity we all indulge in more or less sleeping. After you have read this treatise you will be a sleep scientist. How can we get to sleep more quickly? How much sleep do we need? How does noise affect sleep? Do dreams affect the benefits of sleep? What types of covering, mattresses, and springs will best promote sound sleep? These are a few of the aspects of sleep covered in this semi-scientific work. The authors deny categorically that they were subsidized by any maker of beds, bedding, pyjamas, negligees, or cures for insomnia; they have tried merely to ascertain scientific facts about sleep, no matter whom these helped or hurt. The book makes easy reading, though it is packed full of fact, and is suited to the understanding of mere mortals. $2.65 postpaid *A. G. I.*

PIONEERS OF FREEDOM —*By Sveinborn Johnson*

HERE we have vivid account of the Icelanders and the Icelandic Free State (871-1262) issued on the eve of the 1000th anniversary of the founding of the Althing or Parliament of Iceland which was celebrated by appropriate exercises on the ancient site where that body regularly convened for approximately 900 years. It is interesting to see how these isolated people founded and maintained governmental institutions while the rest of Europe was largely in the grip of absolute power and centralized monarchies. Iceland maintained a government strikingly free and responsive to the popular will. This far-away island was perfecting popular institutions while most of contemporary Europe was drifting towards despotism. Under the influence of civil and political liberty there flourished a legal system which in excellence rivaled that of Rome; and during the same period a literature blossomed which contained some of the finest creations of the human mind. The government finally collapsed because of elementary defects and a spirit of lawlessness. $3.70 postpaid—*A. A. H.*

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THIS is a definite record of the most heroic and spectacular last-ditch defense of the great war written by the man himself who conducted that defense to a successful conclusion. The author presents no argument, makes no bid for fame, he tells the facts with an impartiality that is amazing. Judgment on the German commanders is free from bias; the Crown Prince is given credit for a humanity the world has little suspected. But the most significant statement, in view of the comparatively quick demolition of Liege, Namur, and Maubeuge, is that permanent concrete fortifications such as Douaumont when properly manned and equipped can be of indispensable value in maintaining a defense and will resist the fire of the heaviest ordnance. The style of narrative is of such perfection and the generalizations are so clear and comprehensive as to make this work one of the literary gems of war history. $4.20 postpaid.

PRINCIPLES OF SCIENTIFIC PURCHASING —*By Norman T. Harriman, Bureau of Standards*

A LONG experience in railroad purchasing and specializing for the last nine years in the standardization of purchasing and its procedure of the Federal Government under the Bureau of the Budget, has given the author a sweeping comprehension of the fundamental necessities, the basic rules of scientific buying, and the philosophy of Budgetary Control that applies equally well to private business. A complete summary and thorough analysis of the best present day practice. $3.25 postpaid.

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Attorney's Delay Unavoidable

A DELAY of a few months in filing an application for a patent, due to the accumulation of business before the patent attorney entrusted with the filing, does not show a lack of diligence on the part of the applicant in prosecuting his claim to an invention and a patent therefor, the Court of Customs and Patent Appeals has ruled in an appeal from an interference proceeding in the Patent Office, according to *The United States Daily*

The court held that the Patent Office had properly awarded priority of invention to George W. Heise as against the senior applicants, Martus & Becker, for certain improvements in battery cells.

The invention, the opinion states, "relates to the addition of zeolitic agents—one of which is 'permutit'—to the electrolyte in a caustic alkali electric cell for the purpose of increasing electrolyte efficiency."

Plan to Include Patents in War Settlement Favored

THE House Committee on Ways and Means at a recent hearing agreed to report favorably a bill (H.R. 9142) to extend jurisdiction of the Arbiter under the War Claims Settlement Act of 1928 to "patents licensed to the United States pursuant to an obligation arising out of their sale by the alien property custodian."

The purpose of the bill, according to the Special Assistant to the Secretary of the Treasury, E. C Alvord, who testified before the Committee, is to extend the Arbiter's jurisdiction to the chemical foundation patents.

The 1928 act provides for compensation to alien owners of patents for use, or licensed to be used, by the United States, the licenses being restricted to those issued by the alien property custodian. That, according to the Government, left out the so-called chemical foundation patents, and at the time the case of the Government against the chemical foundation to set aside the sale of the patents involved, on the allegation of fraud in the sale, was pending in the courts.

Limited Novelty--Limited Claims

THE Board of Appeals has held that one claim only is allowable in a patent application covering an invention relating to the production of a water-resistant, porous, rigid, coherent mass by puffing the mixture of a ground filler and a water solution of sodium silicate, according to *The United States Daily*.

The slight novelty of the invention over the prior art was held to warrant the allowance of but one claim, the others being held not to be patentably distinctive.

The finished product of the invention is said to be suitable for use as a building material. The invention is alleged to be based on the discovery that the maximum resistance to moisture is obtained under certain conditions, they being Particle size of the ground filler, composition of sodium silicate solution, and ratio of sodium silicate to filler.

British Mail Ban on Cigarettes

GREAT BRITAIN is seizing parcels containing sweetened cigarettes made in America and other countries which are being sent through the parcel post mails in violation of British postal regulations, according to advices received by the Post Office Department and made public in a memorandum sent to postmasters, who are to advise mailers that such parcels will be accepted only at their risk.

The brands of cigarettes affected are all popular in America, and are mailed principally by individuals as gifts to friends abroad and not by the manufacturers who sweeten their products to meet the taste of smokers, it was stated orally.

The full text of the memorandum follows:

In view of the existing prohibition in Great Britain against the importation of sweetened cigarettes, numerous reports of the seizure of parcels containing these articles are received from the postal administration of that country.

As practically all brands of cigarettes manufactured in the United States contain a certain percentage of sweetening properties, postmasters will advise mailers that cigarettes addressed for delivery in Great Britain will be accepted only at their risk.

Reduction to Practice Governs Priority

AFTER an invention has been reduced to practice, the abandonment of the invention will not be inferred merely from failure speedily to file an application for patent or to commercialize the product, the Court of Customs and Patent Appeals has ruled. Abandonment must be affirmatively proved, it was ruled, according to a recent issue of *The United States Daily*.

The opinion of the court states that "the diligence required of one claiming to be an inventor is primarily diligence in reducing to practice after conception, and the law is not so much concerned with speed in filing application for patent, provided, of course, there is no secreting or abandonment of the invention."

The court affirmed the Patent Office in awarding priority of invention for a process of manufacturing formamide to Burritt Samuel Lacy, who did not file an application for patent until three years after the conception of the invention and its reduction to practice.

The subject of the invention, according to the opinion, is a "process for the production of a material called formamide, one of the uses of which is as a raw material in the production of hydro-cyanic acid much used as an insecticide for fumigating citrus trees, ships, rooms, and so forth."

In another case involving the question of reduction to practice, the Court of Customs and Patent Appeals has upheld the Board of Appeals of the Patent Office in ruling that priority of an invention of a process for vulcanizing rubber involving the use of so-called high-power accelerators should be awarded to Sidney M. Cadwell over Marion M. Harrison and Harold A. Morton, whose assignee is the owner of patents No. 1434892 and No. 1434908, for the process. The patentees were the junior parties, the Cadwell application having been filed previous to theirs, although patents have been issued to them.

The opinion describes the steps that have been taken in the art of vulcanizing rubber. Problems arising in the use of high-power accelerators were solved by both parties, it is stated. The sole issue between the parties on appeal was which had first reduced the invention to practice.

The court held that the numerous laboratory tests conducted by the appellee in the usual way for determining proper vulcanizations, which tests were in common use in the rubber laboratories of the country, constituted a sufficient reduction to practice although no factory tests were made nor commercial operations conducted.

Pay for Service Is Not Free

"FREE" spectacles to a customer who would obtain orders for glasses from other persons were offered by the Clear Sight Spectacle Company, Chicago, but the glasses were really not free, according to the findings and an order to cease and desist just issued by the Federal Trade Commission.

"Take the scientific self-tester you now have to your friends," the customers were advised. "Ask them to make a test of their eyes as you have done. They too should have the benefit of our expert service and low price.

"Tell them you are going to order a pair for yourself and that they might as well send their orders with yours.

"Collect one dollar deposit from them and they can pay the balance to the mailman upon delivery. They will receive the same, strong iron-clad guarantee of satisfaction for five years to come.

"You may keep the one dollar deposit you collect as your pay. Take only four orders and you will earn more than enough to pay for your own glasses. Take as many orders as you can. You make one dollar each."

The Federal Trade Commission has ordered the company to cease and desist from representing the spectacles as "free" when the fact is they are not given free but "in consideration of personal services rendered or performed by certain customers in securing for respondent cash orders for two or more pairs of its spectacles from other customers."

Customers were invited to take two orders with a dollar deposit on each, send in the two orders and the two-dollar deposit. The person taking such order was to obtain his own glasses "free."

"Only one free pair of spectacles will be sent into a community," read an advertisement.

In one instance the company described its proposition as a "Special Ten Day Offer."

But the commission has also ordered the respondent to discontinue representing that the spectacles "can be obtained at the prices stated for a limited period of time only, or that said spectacles can be purchased by a limited or restricted number of persons only," as these restrictions were not put into effect.

"Army and Navy Supplies" May Be Misleading

NATHANIEL ABRAHAM, trading as N. Abraham Company and Warehouse, in San Francisco, offered for sale paints, automobile oils, and varnishes as "Army and Navy Surplus Supplies," when in fact this merchandise had never been the property of the United States Government.

In his advertisements Abraham displayed the following notices: "This Merchandise is Now Offered for Sale at Warehouse, 701 Battery Street, Corner Pacific," and "Warehouse, 701 Battery Street, San Francisco, Mail Orders Promptly Attended To."

Abraham was ordered by the Federal Trade Commission to cease and desist from these misleading uses of the words "Army and Navy Surplus Supplies," or the word "Army" or the word "Navy" standing alone or in connection with the word "Warehouse" or with other words

Parachutes Are Developing

AFTER several years of more or less stagnation, development of parachutes for use of aviators has taken place, according to J. E. Sullivan, of the Bureau of Aeronautics, Department of the Navy.

The industry is a growing one, said Mr. Sullivan, who pointed out that the latest figures compiled by the Aeronautics Branch of the Department of Commerce show that the number of aircraft pilots holding active licenses now totals 10,701. Furthermore, parachutes constitute no minor item in the equipment of an aviator, as they sell commercially for approximately 350 dollars each, although they are bought for military purposes for considerably less.

A cotton substitute for the silk used in parachutes is being subjected to experiments, which has the advantage of being cheaper than silk. While commercial interests are employing cotton to a certain extent, the Bureau of Aeronautics has not arrived at any definite conclusion regarding its use for naval purposes.

There are four major manufacturers of parachutes today while there were only one or two five years ago. A recent improvement made by one manufacturer has been to make the pack perform the functions of the pilot parachute. The pilot parachute on the ordinary parachute is the first to open and drags the large one after it. When the rip cord releases the spring on this new type the bottom of the pack opens and replaces the usual pilot 'chute.

Another manufacturer has improved his product by reducing the size, which, although it makes the rate of descent somewhat faster, opens more quickly. Still another manufacturer, it was pointed out, is working on a triangular-shape parachute, which is claimed to be steerable.

Nearly all the accidents in the past due to the failure of the parachute have been attributable to improper packing or improper operation of the releasing device by the person making the descent, or hasty release of the spring, causing the parachute to open too quickly and catch on the plane.

The present development of parachutes is being worked out to a large extent on increasing their performance characteristics - making them stronger, more durable, with smaller packs and less bulky. The features which the Navy looks for in a parachute are the certainty and rapidity of opening, slow rate of descent which must be about 20 feet per second, and non-oscillating.

"Dry Ice" Package Patent Valid

THE Slate patent, Number 1595426, for a refrigerating apparatus using solid carbon dioxide, so-called "dry ice," principally used for packing for shipment food products not damaged by excessive freezing, has been held valid by the Circuit Court of Appeals for the Second Circuit

The defendant company, which was alleged to have supplied solid carbon dioxide for use in the plaintiff's packages, was also held by the court to be a contributory infringer of the patent.

The court over-ruled the defense of invalidity of the patent, holding that while the use of carbon dioxide as a refrigerant had been long known in the art, the arrangement adopted by the patentee in his apparatus was not anticipated.

The patentee was stated to have reversed the usual process by placing the refrigerant in the center of the package, surrounding it with ice cream or other substance to be refrigerated, and enclosing all in a packing box or insulating wrapping.

The court held that the method of utilizing by specified physical means the operation of a law of nature is patentable, thus overcoming the objection that a law of nature may not be patentable.

It was also found not to be fatal to the patent that the solid carbon dioxide is to be destroyed by its use as a refrigerant.

The doctrine of implied license to renew perishable and subordinate parts was also held not to be applicable to the perishable solid carbon dioxide, particularly where the exclusive licencee of the owner of the patent sells carbon dioxide with a license to use it in the package described in the patent.

Malt Product Mark Restrained

THE owner of the trademark "Budweiser," for malt syrup and other products, has been held by the District of Maryland to be entitled to an injunction restraining the use of the notation "Budd-Wise" on malt products. The matter was referred to a master for an accounting.

The court ruled that the defendant's allegation in answer to the suit for infringement that the plaintiff was deliberately and intentionally selling its goods for use in violation of the prohibition act and that its goods are not fit for legitimate use should be stricken from the pleadings as irrelevant and impertinent.

It was further held that the fact that the defendants had procured a copyright of their label was immaterial in a controversy as to trademark infringement, the copyright giving the defendants no trademark rights whatsoever.

Patents Recently Issued

Classified Advertising

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Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co, those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co, 24 West 40th Street, New York City

Pertaining to Aeronautics

AEROPLANE—An amphibian air liner, in which the body simulates a bird, is particularly adapted for flying in sleet and snow, exhaust gases being utilized for heating the body and for preventing the formation of ice on the wings Patent 1757879. John T Rydberg

Pertaining to Apparel

REAR YOKE FOR DRESSES—A reinforcement which extends from the rear opening at the neck to the sleeve openings and downwardly to the lower part of the sleeve opening for protecting the dress against perspiration without detracting from the pleasing appearance Patent 1758852. Louis C Rosenblatt

Chemical Processes

PROCESS FOR RECOVERING BORAX FROM BRINE—Containing borate in solution together with sodium carbonate, which consists in treating the brine with carbonic acid gas to precipitate from the solution, and crystallizing out the borax by cooling. Patent 1756122 Henry D Hellmers.

PROCESS FOR INCREASING THE LUSTER OF GOODS MADE OF ANIMAL HAIR AND WOOL. Particularly felt and velour in hat bodies by bringing into contact therewith an aqueous solution containing chlorine and hydrogen ions, and an aqueous solution of peroxide of hydrogen, and causing the two to react with each other in contact with the goods Patent 1760738. Erich Bohm

Designs

DESIGN FOR A DRESS—Patents 81098 and 81099. Dorothy Long

DESIGN FOR A TEXTILE FABRIC OR SIMILAR ARTICLE OF MANUFACTURE—The inventor has been granted two patents, 81252 and 81255. Joseph H Mack

Design for an Ensemble Suit—Patent 81139. Dorothy Long

Design for a Suspension Bracket—Patent 81168. Robert D W Vroom

Design for a Candy Doll—Patent 81245. Mildred C Knapp.

Design for an Ensemble Suit—Patent 81251 Dorothy Long

Design for a Textile Fabric or Similar Article of Manufacture The inventor has been granted two patents, 81235 and 81236. Herman Haug

Design for a Textile Fabric or Similar Article of Manufacture Patent 81238. Christian Hoffmann

Design for a Suit—Patent 81100 Dorothy Long

Electrical Devices

Electric Furnace Such as those usually employed in dental laboratories, which will be capable of generating the necessary amount of heat with much lower resistance than usual, constructed in a simple manner prolonging the life for an indefinite period. Patent 1757895 Andrew J. Asch.

Radio Tube Which may be used in several different ways, such as a detector, an amplifier, a static eliminator, etc , provision being made whereby the characteristics of the tube may be changed to effect the desired results. Patent 1757345. Howard M. Strobel

Thermostat Forming part of an electrical circuit, in which a thin strip of resilient material is bent and maintaned under a predetermined stress, so that when expanded by heat it will suddenly buckle, thus instantly breaking the circuit Patent 1758787. Arnold Escher.

Electric Water Heater—Adapted to be readily associated with or removed from a sink or similar kitchen or household fixture, whereby the water passing through coils brings it in contact with various portions of the heating element Patent 1759774. Angelo Andriulli.

Fluid-Operated Circuit Controller—Which is capable of controlling a circuit including a signal for indicating to the operator of a motor vehicle whether or not the lubricating system of the vehicle's motor is properly functioning and sufficient lubricant circulating. Patent 1759537. Walter C and Arthur R Buckbee

Of Interest to Farmers

Stalk Cutter—A farm implement which includes a frame having equal portions extending on opposite sides of a draw bar and carrying knife-equipped rotors for cutting stalks and chopping them up, over at least four rows. Patent 1757873. John F. O'Kelley

Of General Interest

Marcelling Iron—Comprising a plurality of forks disposed one above the other and means for moving certain of the forks laterally with respect to the others, the other forks remaining stationary, may be worked in the same manner as hair clippers. Patent 1756104. Nellie Stone.

Condiment Holder -A partitioned container, wherein salt and pepper may be served from a single holder, the construction is simple, while at the same time functioning to prevent the mixture of the condiments, and keep them moisture proof. Patent 1757525 Frank A. Hart.

Easel—Comprising two strips of material forming a U-shaped frame having an L-shaped bracket capable of holding and displaying thin objects such as paintings or photographs, or thicker objects such as books. Patent 1755518. Edward M. Roberts.

Closure Cap—For milk bottles, or any form of container where disk-shaped cardboard caps are used for closures, whereby the cap may be gripped by the hand and easily removed entirely eliminating the use of an instrument. Patent 1755522. Samuel J. Smyth.

Optical Device—Primarily intended for amusement purposes, optical illusions being produced when viewed by a person, or if employed in connection with an ordinary or motion-picture camera, such optical illusions will be reproduced on the film. Patent 1758801. Bertram Moses

Means for Acoustical Correction and Sound Deadening—For absorbing sound by causing reverberation or resonance of sound in a manner which eliminates interfering echoes, or which confines sound refection to a determinate non-interfering limit or area embodied by walled structures. Patent 1758808. Fred J. Sersen and Kenyon B. Conger.

Plant Support—For growing plants which includes a post adapted to be driven into the ground alongside of the plant and a girdle adjustable, vertically on the post and circumferentially, in order to compensate for growth of the plant Patent 1758839. Theodore Kelsey.

Adjustable Mirror for Barbers' Chairs and the Like—Whereby the mirror may be moved to various positions so that the occupant of the chair may view the results of a hair cut, wave, or the like, the mirror being adjustable for customers of different heights. Patent 1758021 Peter D Barakauskas.

Aspirating Head for Flowing Liquids—An aspirating head for submergence in a well or reservoir of liquid to produce a jet of suction-producing gaseous fluid under pressure causing movement of the liquid in a flow line. Patent 1758812 George McW. Williamson and Glasgow W. Haywood.

Tellurian—An orrery, specifically a tellurian having sun and earth sphere mounted for bodily movement of the earth relative to the sun in a path denoting the ecliptic circle. Patent 1758759. David Phillips.

Combination Brush, Comb, and Mirror—In which the various parts are entirely enclosed when not in use, thus keeping them clean and sanitary, the casing being divided into brush-receiving and comb-receiving compartments, one of the partitions forming a mirror. Patent 1757999. Christoph Hagen.

Price Tag or Sign Holder An attachment for supporting tags from the edges of shelves, which affords a means for associating the tags either in an upright or depending position, an advantage where two varieties of stock are arranged on one shelf. Patent 1759781. Louis Fontannaz.

Loud-Speaker Envelope—Comprising an envelope body including conical walls secured together at the major portions of their edges, leaving an opening constituting a sound outlet, functioning to produce more individual notes and less harmonics Patent 1759785 Roy H. Guldman.

Cooking Pot of the Self-Closing Type for the Cooking of Food—Having a cover adapted to be placed in position and removed, by sliding and rotating horizontally, thereby preventing its contact with the food and providing more food-containing space within the vessel. Patent 1759732. Moise A. Charlot.

Seat Back-Rest—A collapsible back-rest for association with board seats, such as are employed in row-boats and bleachers on baseball and athletic fields, thus producing a comfortable and rigid seat structure which may be effectively secured. Patent 1759694. Peter Greenwood.

Device for Removing Eggs from Fish Hatcheries—More particularly for the separation and removal of dead eggs from the live eggs in the hatchery troughs, thus preventing the development of fungus liable to destroy the health of the live eggs during the period of incubation. Patent 1759729. Joseph Berger.

Nested Chair—Which may be formed as a chair or a table and readily nested for shipment or storage, the structure being formed either of wood, metal, or a combination, and the parts so constructed as to telescope. Patent 1758826. Louis Dellert.

Massage Device - Which comprises a plurality of vacuum cups, one being disposed within the other, the inside one being of less height than the outside one, thus producing a greater suction and a more effective massage to the skin. Patent 1758962. Carl Miller.

Adjustable Furniture—Especially adapted for printing establishments, having two opposed edges swingable at various angles with respect to each other, so that a cut may be locked in the chase on a bias, thus obviating the use of specially cut wood. Patent 1758980 Wayne F Rossiter.

Safety Barrier for Roadways—For placement along dangerous curves or embankments on a highway, which in the event of being hit by a motor vehicle will eliminate or reduce the shock to a minimum, both to the barrier and the vehicle. Patent 1759794. William McDade.

Oarlock—Formed integral of metal, with an oar-receiving eye supported for swinging movement by a pin and socket in upright position above the gunwale of a boat, and having means for preventing displacement of the oar during rowing. Patent 1757378. John E. Mathewson.

Combination Ladder, Step and Support—Which may be positioned wherever desired, along the length of the ladder at an angular position of a building or roof, and will also function to support a bucket. Patent 1760803. John Wirth.

Hose Coupling--Consisting of male and female members with simple means for positively locking them to form a fluid-tight joint, and whereby a worn male member may be replaced by a new one and the desired connection assured. Patent 1761352. Henry H Logan.

Memory Pad—Having means for covering a portion of the subject worked upon, thus causing the student to recall by memory the portion covered, the entire sheet may be covered for constant repetition until the problems are memorized. Patent 1760408. Rebecca E. Hooper.

Stopper for Gas and Water Mains—An inflatable stopper which will be effective in forming a complete closure for the main, the proper emplacement not being prevented by buckling or deformation after its insertion, means are provided for ready insertion and removal. Patent 1760750. Patrick Goodman.

Display Device—Showing in miniature the reproduction of a pattern of dress material proportionately reduced to enable a purchaser to determine how the garment will look when made up, through a reduced picture of the garment and the material selected. Patent 1760792. Bernard F. Stenz.

Mounting Anchor—Particularly adapted for mounting the corner clips in decorating pocket books, bill files, wallets, or the like, serving to positively secure the clips in attached relation, without marring the appearance of the cover. Patent 1760728. Murray A. Wachs.

Comb—Characterized by being conveniently manipulated to form a compact case excluding dust and dirt, may be carried in a pocket, pocketbook, or form part of a traveling kit, the teeth are formed to be substantially self-cleaning. Patent 1760778. Henry J. Ries.

Article Support—A simple means for holding paper or other bags in open position, for dropping into the same waste material or refuse from household kitchens, the bag may be readily detached from the support and placed in a garbage can. Patent 1760752. George D. Happer.

Hardware and Tools

Hoe—Having a plurality of interchangeable blades for performing various garden operations, and a durable and interchangeable shank is provided between the blade and handle for withstanding a maximum strain; handles of various length may be used. Patent 1757882. Ernest F. and Alfred Sill.

Casing Cutter—Which is provided with automatic means for gripping the interior wall of the casing at any desired depth, the cutting means being actuated by the weight of the drill stem, and jars for severing the casing. Patent 1756128. Albert M Monroe.

Suspension Hook -Which may be formed from a single piece of metal, will be durable and will readily support a framed picture or the like at various angles, without liability of slipping, or disengagement of the suspension cord. Patent 1757875. Thomas S Rainey.

Locking Device—Especially adapted for windows, automatically locking the sash together when in closed position and providing means for rigidly holding the window against lateral vibration, may be readily used on doors, cabinet doors or the like. Patent 1758337 John C. Sheller.

Knob-Attaching Device For securely holding the knobs of covers for pots, kettles and the like, may be readily screwed into place, and is automatically locked against accidental removal, may be used in connection with old covers. Patent 1759771. Otto B. Willi.

Adjustable Cutting Instrument—In which a blade is provided with two cutting edges adjustable to expose more or less of the edge as required, whereby the manual manipulation of the cutter or scraper will be greatly facilitated. Patent 1755535. Otto M Bratrud.

Wrench—Having a jaw head which may be manually rotated to assume various angular positions, so that it may be used from different starting positions in operating a nut or bolt which is particularly difficult of access. Patent 1755486. Ross E. O'Dell

Lock A simple locking means wherein the bolt is projected by gravity, eliminating the use of springs, which cannot be "picked" or manipulated by a skeleton key, from the outside of the door. Patent 1758872. Robert Wheeler.

Heating and Lighting

Furnace—Having a coal hopper in open communication with the casing, and a mechanical stoker operated from the floor above adapted to force a charge of fuel onto the grate, the fuel, including the volatile products being completely consumed. Patent 1757878. Carl H. Root.

Attachment for Gas Water Heaters A form of cowl, readily applied to the conventional type of heater, serving to direct the hot gases into intimate contact with the hot water discharge pipe, before such gases are dissipated into the air. Patent 1758788. Alexander H. Frank.

Domestic Incinerator—Which rapidly desicrates refuse and maintains a sufficiently high temperature to drive off volatile moisture without recondensation in the incinerator or in the stack, completely consuming fats, carbohydrates and other garbage without appreciable odor. Patent 1758487. Harry L. Warren.

Machines and Mechanical Devices

Centrifugal Pump -In which roller bearings and lubricating oil may be used, all possibility of the oil coming in contact with the liquid passing through the pump being eliminated by the use of wear-compensating rings, instead of packing. Patent 1757670. Herman L. Keun.

Mechanical Pencil—Wherein a thin flat lead may be employed and fed as desired, at all times producing a line of uniform width, particularly adapted for draftsmen requiring a certain kind of point for their work. Patent 1757884. Edgar C. Tuggle.

Pump—Wherein a sort of floating dam may be mounted in a comparatively swift stream, to form a double acting force pump driven by a waterwheel, for delivering a maximum quantity of water to any desired point at minimum cost. Patent 1757885. Grant Weaver.

Oil Pump—Adapted for continuous high-speed operation in connection with oil or other wells of great depth, being operable with a minimum of care, and containing few parts which are liable to get out of order. Patent 1755516 Edward P Reynolds.

Method of and Apparatus for Reactivating Charcoal—For the revivification of charcoal laden with organic matter as in sugar refining, by passing the charcoal through a kiln and subjecting it to a continuous recirculation of pre-heated hot gases which support the combustion of organic matter Patent 1758202. Edgar W. Rice.

Ship-Propelling Means- A form of hydraulic ship propulsion, an assemblage of mechanism whereby a jet or stream of water is directed rearwardly and downwardly for propelling a ship forwardly, or in a forward direction for reversing the vessel Patent 1758847. Amos C McIntosh

Oil-Well Pump—In which the expulsion of a combustible gas is employed in such relation to the oil within the well as to subject the latter to a series of lifting impulses, until it is finally ejected from the well Patent 1758346. Armais Arutunoff

Fluid-Dispensing Apparatus_Characterized by its ability to control dispensing of different flavoring syrups from different sources of supply, and carbonated water, through a single nozzle, and by the employment of a single valve, particulary adapted for use at soda fountains. Patent 1758552. Philip S Allen

Gas and Liquid Contact Apparatus A tower for the absorption of gases in liquids or their distillation therefrom, means for delivering liquid from one section to another, a plurality of enclosed bubbling trays, and means for controlling the temperature of particular trays Patent 1759750. Meinhard H Kotzebue

Variable-Speed Mechanism In the form of power-driven or automatic scissors intended especially for barbers' use, may be driven by any suitable means, for instance, an electric motor or other power or by hand Patent 1760712. Tatsuji Morimoto

Dry Cleaning Machine—Characterized by the functional relationship of a movable body, within a casing, upon which apparel to be cleaned is supported and adapted to move in a cleaning liquid, and to circulate the liquid around and through the article Patent 1760218. Onesime Thibault and Robert Reid

Indicator for Wrecked Submerged Crafts—Such as submarines, boats, aeroplanes, etc, in which novel means of pressure-actuated release is used for freeing a buoy when the craft sinks to a predetermined depth, or may be manually or automatically released. Patent 1759839. Peter M. Cirimele.

Grader for Vegetables, Fruits and the Like—A rotatable sorter, in which the articles to be graded are fed to one end of the machine and during their passage therethrough are discharged at different points according to the sizes of the articles. Patent 1760712. William G. Bunker.

Curtain Holder- -Which may be attached and positioned to hold a window shade away from the window so as to permit a free circulation of air without permitting a view of the interior of the room from outside. Patent 1760701. Godel K[illegible]noff.

Plumbing and Fittings

Copper - Boiler Outlet — Wherein the threaded portion of the outlet is welded to an extension of the boiler with anchoring means for including solder surrounding the thread, whereby a mechanically strong and air-tight structure is produced. Patent 1758869. Albert H Trageser and Louis Hassinger

Pertaining to Recreation

Fish Lure—An artificial bait, for casting, trolling, or still fishing, which when grasped by the fish will automatically release a hook so that the fish will be impaled thereon, a smooth surface preventing entanglement of the bait with weeds. Patent 1758817. Elwin J. Babbitt.

Stirrup—Having flexible portions for obviating the possibility of a rider's foot being held in the stirrup, should the rider be thrown out of the saddle, and which is more comfortable than the usual rigid type of stirrup. Patent 1758930 Archibald D Cameron

Toy Pistol—Adapted to hold and "shoot" by release, a plurality of elastic bands held under tension and successively releasable rapidly or at intervals as desired, the toy having the properties of a "repeater" or magazine pistol Patent 1759081 Fred T Baum and Clarence G Norris.

Pertaining to Vehicles

Vehicular Signal—Whereby semi-flexible arms are adapted to advise traffic in front or behind the vehicle, the turning direction by mechanism positioned on the steering column, whereby the indicators may be manually controlled for visual positioning. Patent 1757869. William Lapsky.

Vehicle Spring—In which friction between the leaves is increased on the recoil, thereby damping the spring action so that the recoil is much slower, thus improving the riding quality of the vehicle and increasing the life of the leaves. Patent 1757405. Edwin Bagnall.

Reflex Spring—Wherein the action on the downward thrust is free, thereby providing a device which loses none of the easy riding qualities, one of the spring leaves acting as a fulcrum for dampening the action on the recoil. Patent 1757106. Edwin Bagnall.

Safety Valve for Tires—Whereby the inflation may be produced to any predetermined pressure within the limits of the gauge, and upon reaching the predetermined pressure an audible signal will be given preventing further inflation, thus avoiding danger of over-inflation. Patent 1759796 Albert R Miles

Motor-Vehicle Holddown—Constructed from lengths of iron rod bent to provide divergent anchoring barbs at the ends for penetrating the floor of a freight car, for holding automobiles or other vehicles against rolling while in transit Patent 1759733. William B Cook.

Road Magnet Which may be mounted on a suitable vehicle, preferably a motor truck, and drawn over the road for picking up objects liable to puncture tires, the magnetizing motor may be readily removed and used for other purposes. Patent 1759687. Walter M. Carter.

Vending Machine A form of tricycle, the hollow body of the vehicle being in the shape of an airplane, having storage space for commodities, and a seat from which the operator may manually propel the mechanism and control the steering. Patent 1758132. James T. Crow.

Steering Gear—Whereby steering wheels may be set in true alinement even though the steering axle bolt be sheered or otherwise defective, thus increasing the life of the tires and at the same time permitting free and easy steering. Patent 1760719. John F P Gillespie.

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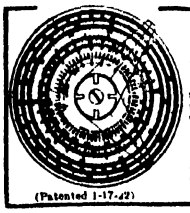

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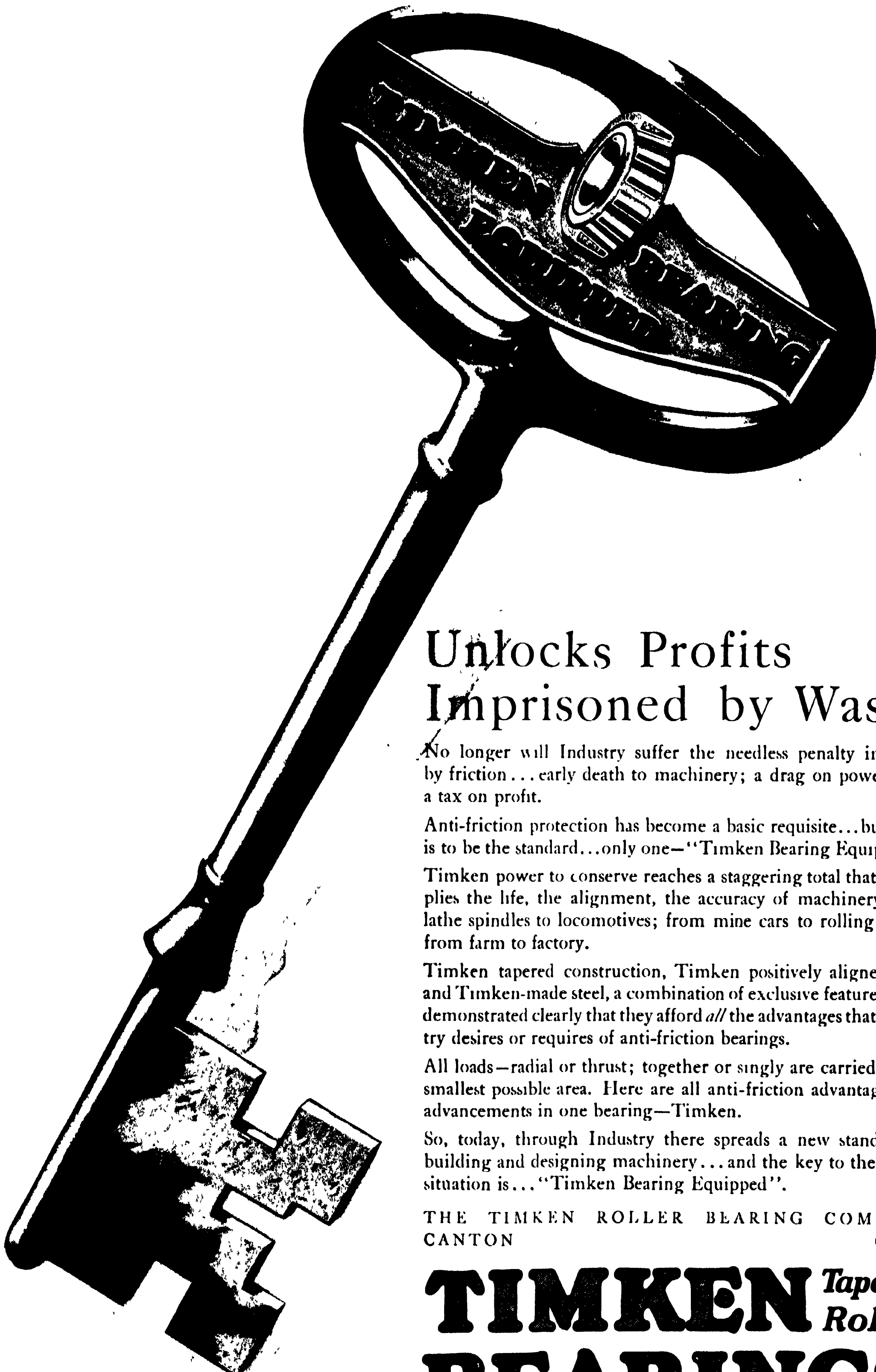

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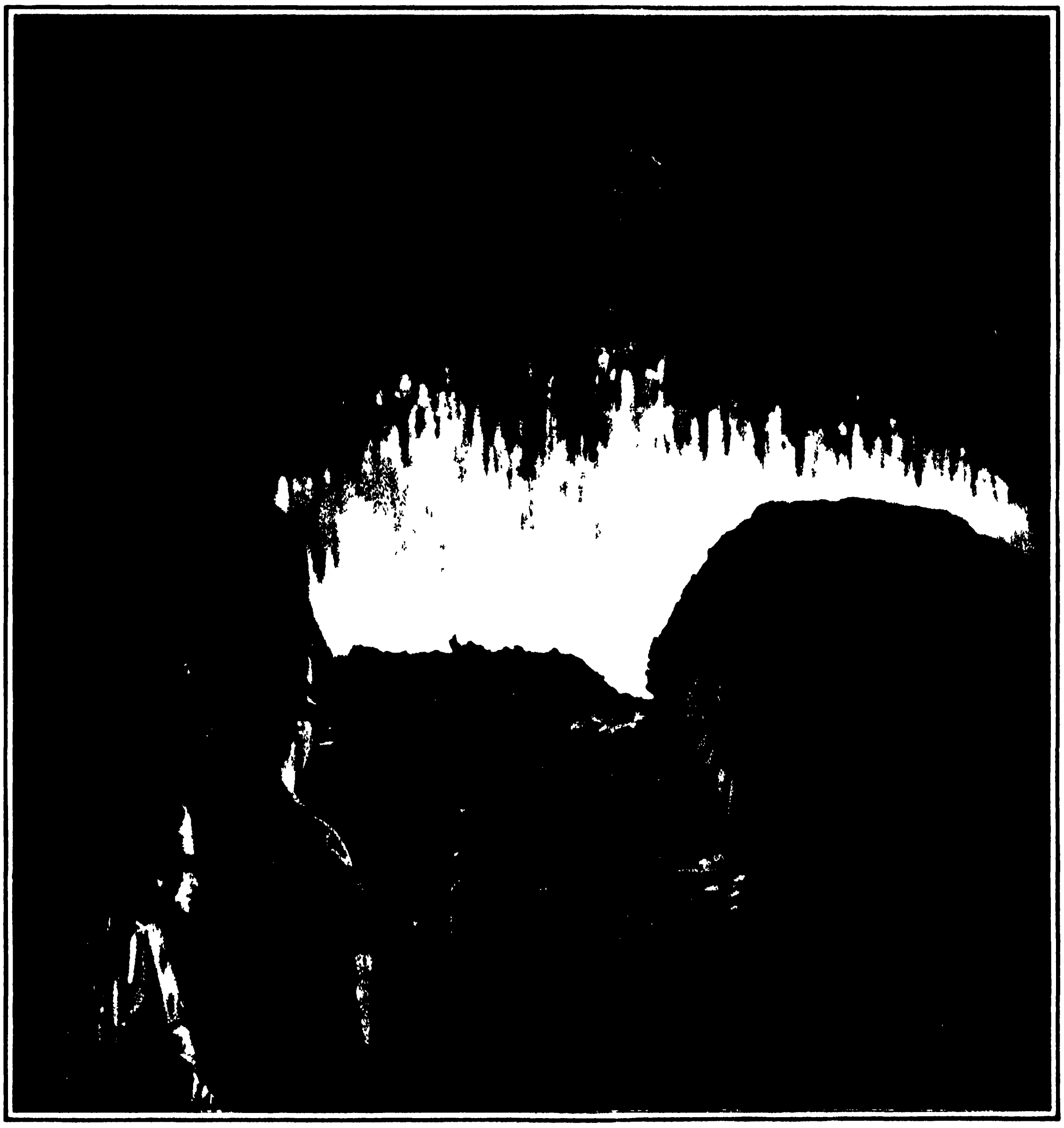

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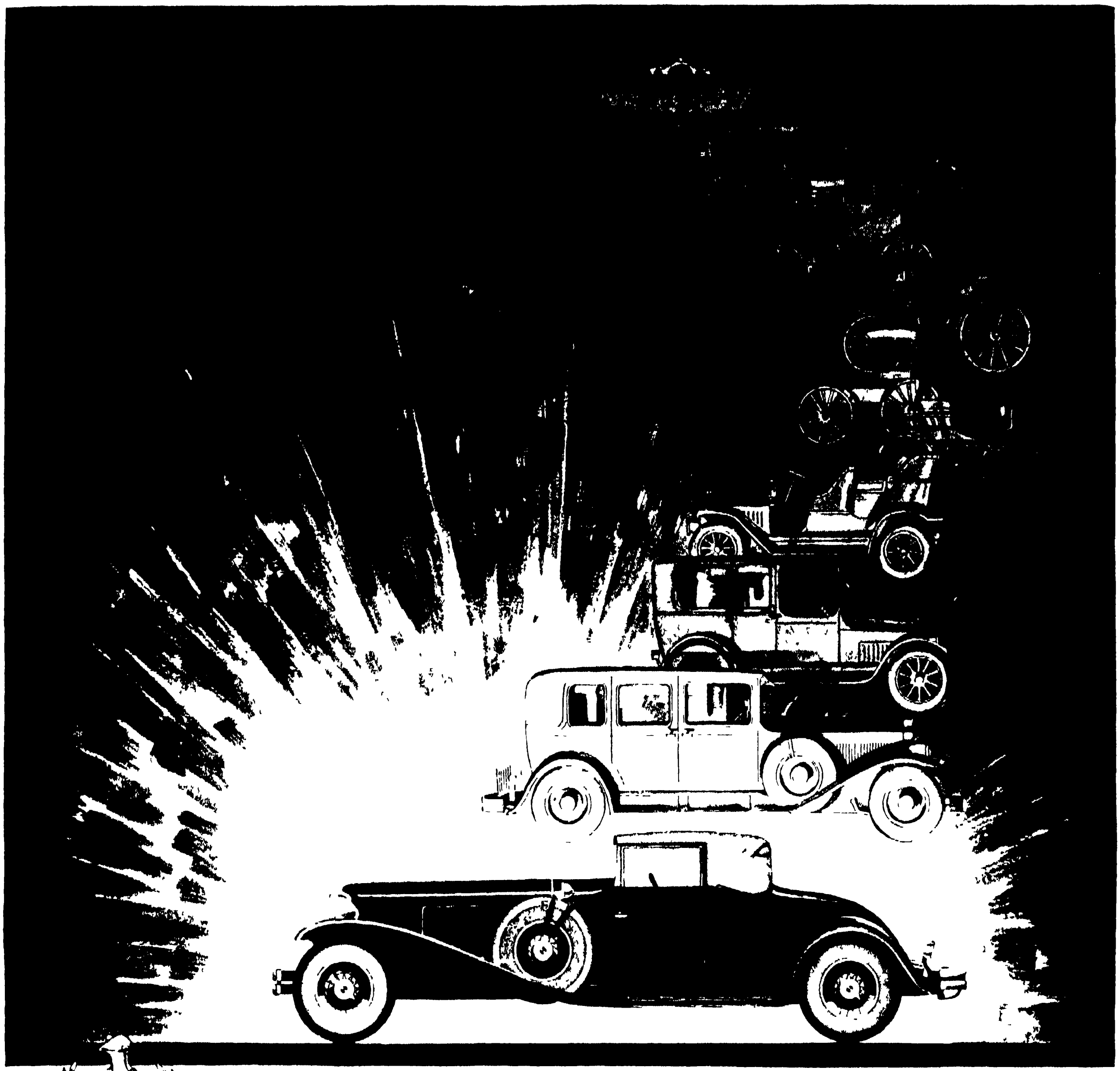

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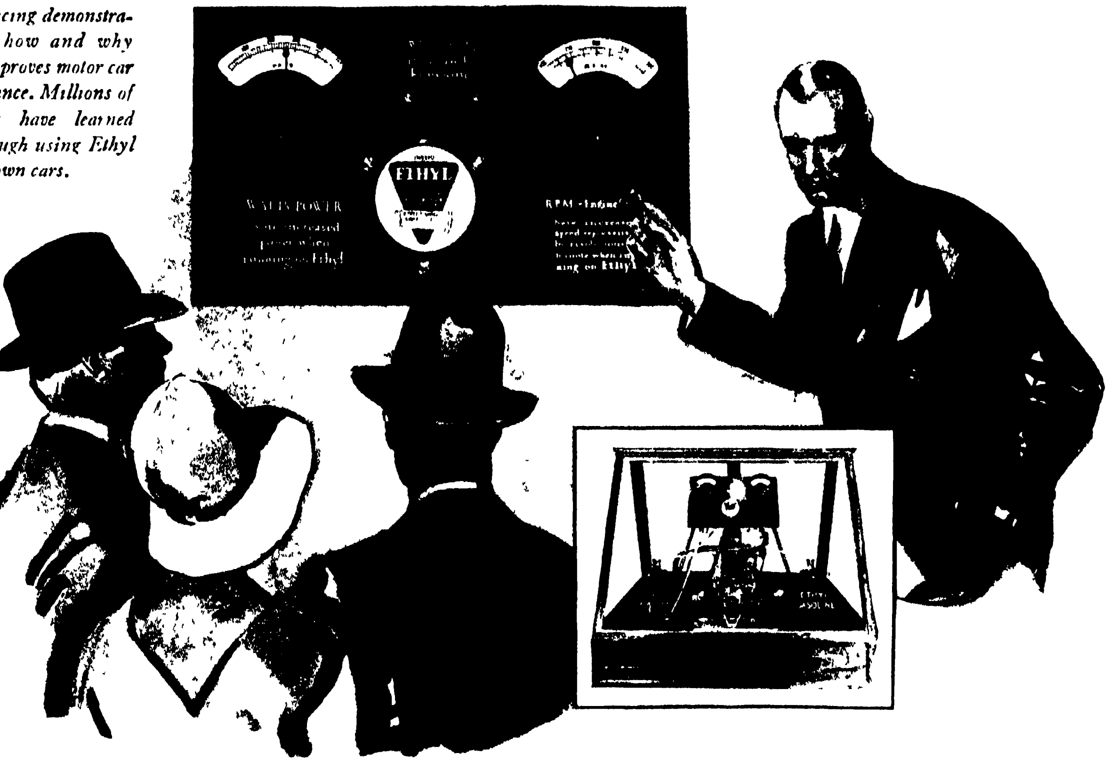

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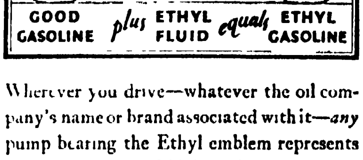

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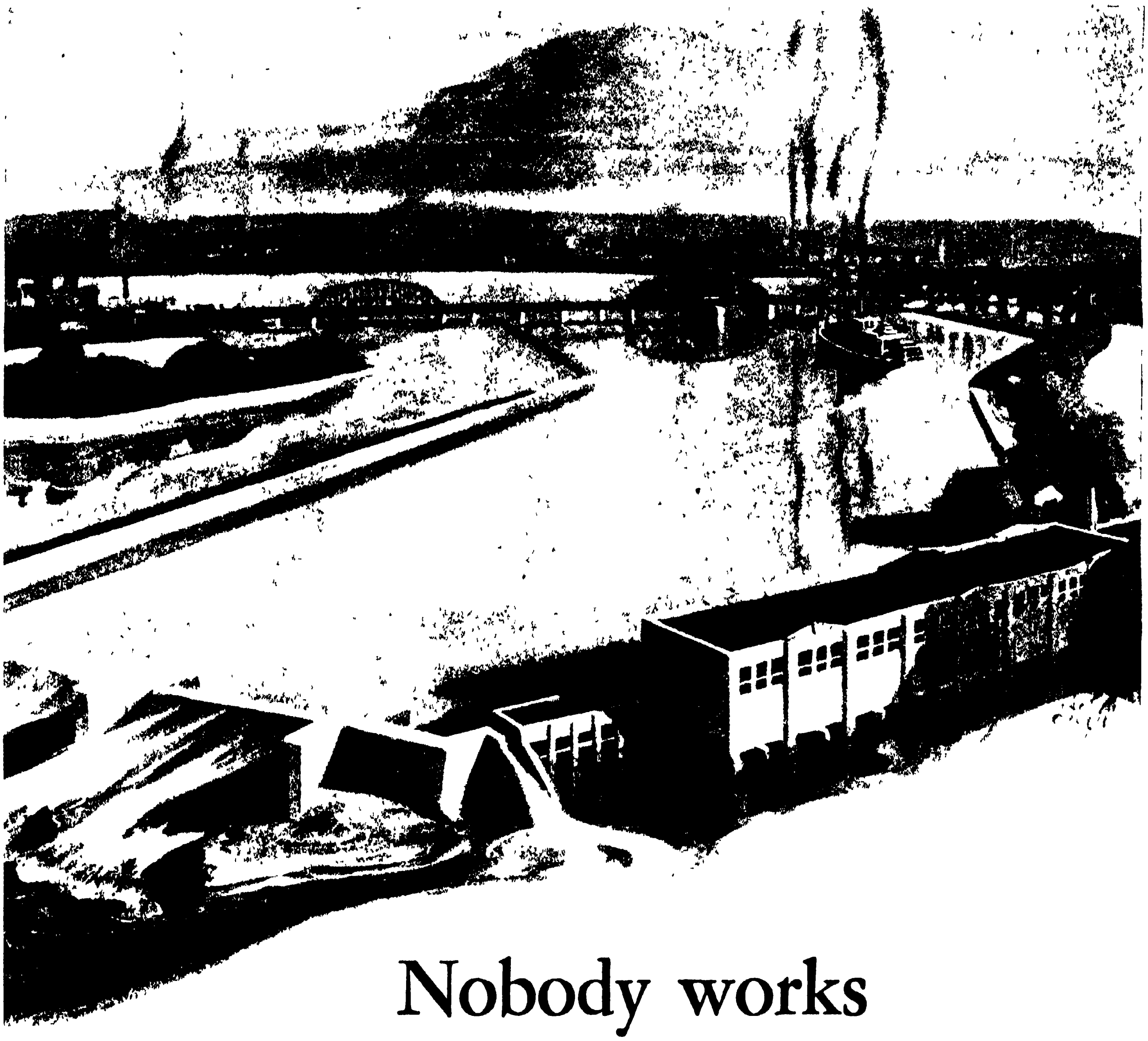

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SCIENTIFIC AMERICAN

September, 1930 **ORSON D. MUNN**, *Editor* *Eighty-sixth Year*

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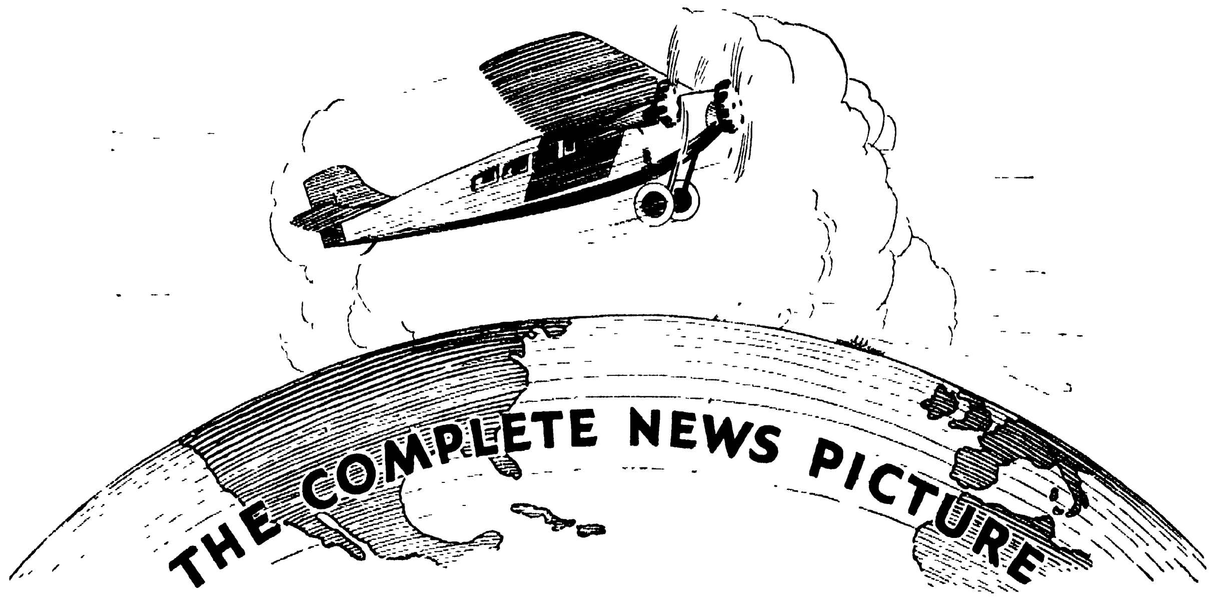
COVER

The vast crater depression of Mt. Kilauea, Hawaii, contains numerous features, one of which is the little "rift oven" shown on our cover, which developed over a rift or crack. The oven "breathed and puffed," says Dr T. A. Jaggar (see page 176), "lava was visible far down the shaft, pale flame played around the orifice under whose lip the interior chamber was bright orange with incandescence, and hung with delicately sculptured fiery stalactites."

See the Whole World Each Month!



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Across the Editor's Desk

As this is written we have before us the advance printer's proofs of the feature articles for this issue. Going through them, page by page, we stopped and reread the article "Railroading Today." No less than when we first read the manuscript, did it bring us face to face with the gripping romance of the mighty networks of steel that have united the far reaches of this country by providing safe and rapid transportation. Old yet always new, the story of railroading in its ever-changing phases holds a unique fascination, probably because it is so intimately interwoven with the very fabric of our every-day existence. We feel sure that you will agree with us that Mr. Milholland is to be congratulated on the story he has written for you this month.

Another article to which we particularly want to call your attention is the one by Dr. T. A. Jaggar on "Volcanology." Dr. Jaggar spends his whole time at the crater of the active volcano Kilauea in the Hawaiian Islands. Thus he is qualified to write with the pen of authority on how the science of volcanology has a direct bearing on the daily lives of each and every one of us, and for that reason his call for amateur seismologists will not go unheeded. Whether you live in the Adirondacks, West Virginia, or on the Pacific Coast, you may, if you answer Dr. Jaggar's call, contribute valuable data to the science of volcanology. Here's hoping that many of our readers will go in for amateur seismology with the same enthusiasm that has been manifested for amateur telescope making.

As long as the evolution of organic life—animals and plants—remains uncertain, there will be two sides to each and every question that arises. Thus, when Dr. Austin Clark expounded *his* theory in our August issue, we felt it only fair to open our pages to any logical refutation of his statements that might be brought forth. And forth it came. Professor Matthew, a paleontologist of high standing, presents *his* side in a masterful article on page 192. Which authority is right? Each reader will have to study the two presentations carefully—and then draw his own conclusions. We remain open-minded.

The Peking man—or woman, to be exact—is fast growing in importance. Professor G. Elliot Smith, who is one of the world's first five authorities on the subject involved, which is called "paleoanthropology," has written an article for you on the Peking man which we feel sure you are going to find of great interest.

These are only some of the high spots that stand out as we scan our proof sheets. Other articles of equal interest and importance cover such subjects as the truth about our much abused patent system; the new type of racing car that is bound to make new history on the speedways; what surgery is doing to rehabilitate cripples; the yachts that have been built to defend the America's Cup; and a dozen or more selected subjects—not to forget the SCIENTIFIC AMERICAN Digest that brings to you the news of all the sciences in brief.

So now we turn to the schedule of the October issue. Of course it is not complete, space having been reserved for important features that are bound to come up at the last minute. But we can tell you something of the articles that are ready for release. Signaling to Mars, that much abused subject so dear to the hearts of the so-called popular magazines, has at last been treated in a logical manner. Even if we could get visual or electrical signals through to the red planet, how could we be sure that there are intelligent creatures there to receive them—humans or animals made up of protoplasm, which is the only criterion of living matter in our experience?

A 69-inch mirror has been cast for a telescope in the Perkins Observatory, as told in an article illustrated by a most unusual series of photographs. And there is a touch of human interest in the background. The funds for the telescope, 330,000 dollars, were provided by the will of the late Professor Perkins of Ohio Wesleyan University. This sum represented the life savings of an 1800-dollar-a-year professor, accummulated through numerous sacrifices on his part and that of his wife, invested judiciously and allowed to flourish at compound interest. Just as the professor devoted his life to science, so did he provide for the continuation of his work after his death.

These articles are by no means all we have to offer for October. The issue will be replete with interest for the astronomer, professional or amateur; several major articles will assure that. There will also be discourses on the cricket's chirp; a gun mount that makes a super-weapon of the 75-millimeter gun; mining of a valuable metal that is recovered from ore by evaporation; the aircraft industry; the sphere in which William Beebe descended deeper into the ocean than man has ever dived before; and other absorbing subjects. All in all, we feel that the October issue will be one of the best we have given you in many months.

Uncle Sam says

LOS ANGELES POPULATION NOW

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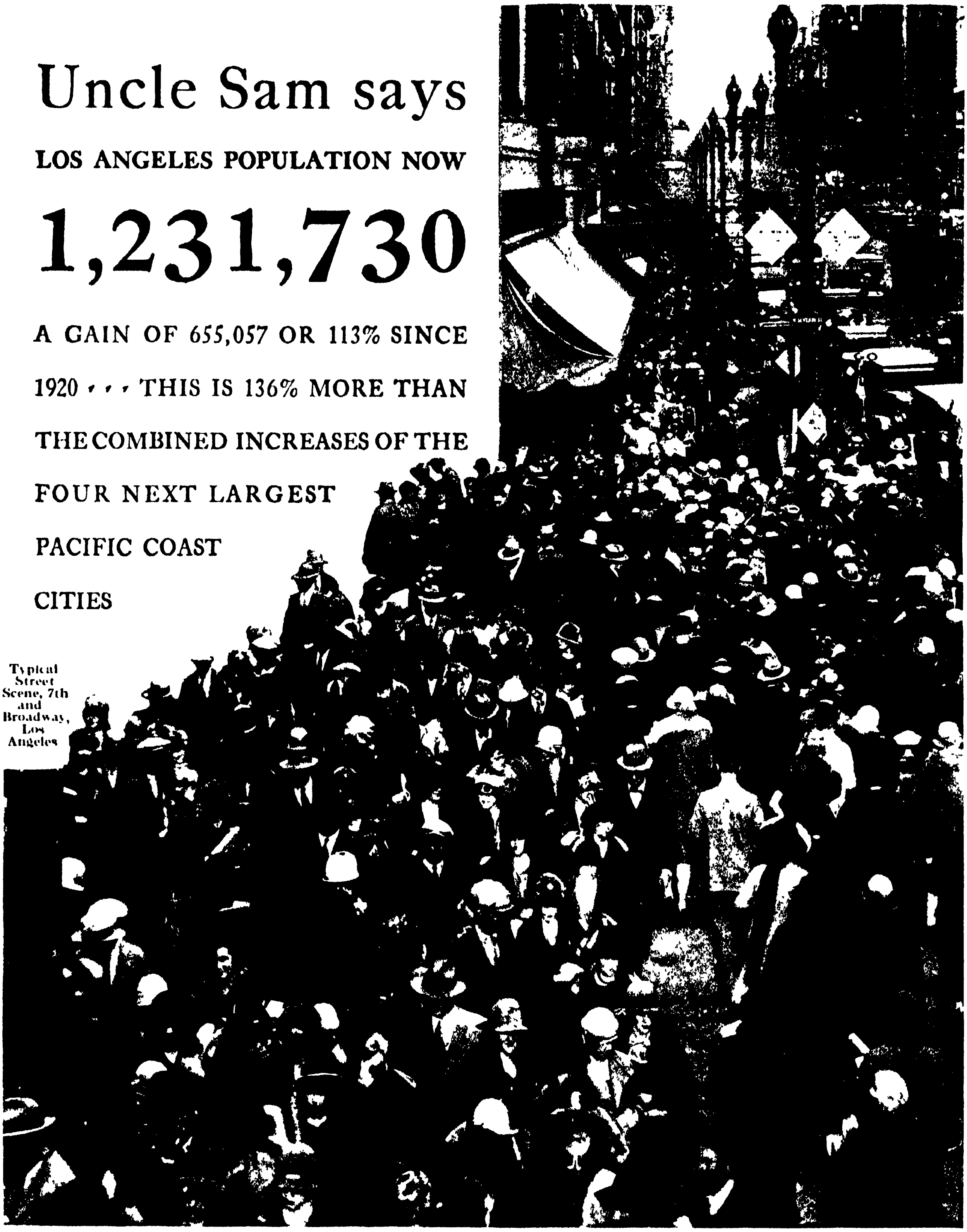
A GAIN OF 655,057 OR 113% SINCE 1920 · · · THIS IS 136% MORE THAN THE COMBINED INCREASES OF THE FOUR NEXT LARGEST PACIFIC COAST CITIES



Typical Street Scene, 7th and Broadway, Los Angeles

Industrial Los Angeles *County*

POPULATION 2,199,657

MANUFACTURING EXECUTIVES ARE INVITED TO WRITE TO THE INDUSTRIAL DEPARTMENT, LOS ANGELES CHAMBER OF COMMERCE, FOR DETAILED INFORMATION REGARDING THIS GREAT WESTERN MARKET

Frank B. Jewett

AN electrical engineer and physicist by training, Dr. Jewett is President of Bell Telephone Laboratories. Here are gathered more than 2500 engineers and scientists with a budget of 17,000,000 dollars. As Vice President of the American Telephone and Telegraph Company, Dr. Jewett also directs the activity of another large technical group. In the 25 years of his association with the Bell System, his guidance has contributed to a myriad of betterments in telephone service, as well as to such advances as transcontinental and transatlantic telephony, the dial system, radio broadcasting, and the high speed submarine telegraph cable. During these busy years he found time to be the head of the American Institute of Electrical Engineers and chairman or active worker in several committees of national importance in the engineering world. The ability to carry forward a number of projects at once is a characteristic which rests mainly upon quickness of perception and accuracy of analysis. All of these traits have aided largely in Dr. Jewett's spectacular progress. That he could enlist the co-operation of hundreds of scientists and engineers is a marked, outstanding tribute not only to his professional ability but to the frankness and sincerity which illuminate his personality.

Courtesy Baltimore and Ohio Railroad Company

The Vanguard of Progress

WRITERS of fiction have woven many romantic stories around the coming and going of the engineers on railroad construction, their loyalty to their jobs, their unceasing efforts to conquer nature and wrest from it a route, in spite of storms, floods, and natural obstacles of all kinds. The engineers who blazed the trails when railroads were new and stretching into the timberlands and the coal fields, were inured to the hard labor of the pioneer. Now, however, the fastnesses of the highest mountains having been penetrated and the paths of commerce clearly marked, the work of the railroad civil engineer, with improved methods and machinery, is less romantic. In former years when railroads were building, these men of the rod, the chain, the level, the stake, and the transit, were found delving into the wilderness, looking for the "saddle" that would get them over the summit. Everyone of the "gang," from the engineer in charge and transitman, down to the lowly stake man and "back rodman," worked hard and long, often under trying conditions—cold and heat—often braving great dangers. Most of the territory has now been covered and the work of the railroad civil engineer is mostly on small projects and maintenance work, except in undeveloped countries of the world.

All photographs courtesy Baltimore and Ohio Railroad Company

The steam shovel does the work of hundreds of laborers and prepares the right of way for new track

Railroading Today—Construction and Maintenance

By FRANCIS X. MILHOLLAND

Assistant to the Senior Vice-President, Baltimore and Ohio Railroad Company

WHO has not, at one time or another, gazed down the length of a straight-away stretch of railroad track and found a fascination in watching the steel rails converge to a vanishing point in the distance? But how many of us know the story, equally fascinating, of how those rails were put there and how they are kept so straight and true the story, in short, of the construction and maintenance of a railroad?

Let us start from the very beginning of this undertaking and consider some of the many problems involved. First, of course, there is the present or probable future need of a railroad as a means of transportation between two definite points. When this has been determined, a corps of field engineers or surveyors start to map out the best and most economical route. From their observations they prepare plans so that the necessary right-of-way can be purchased. They also draw up plans and specifications for the use of the contractor who will do the work of grading.

Now comes the big job of preparing the grade on which the railroad tracks will be built. In this work it is interesting to compare efficient modern methods with the crude means used when the first railroads were built. In former decades, when it was necessary to cut through a hill or along a hillside, the dirt was plowed loose and hauled away with a horse-drawn scraper. When rocks were encountered, the men drilled holes in them with a hand drill and blasted with slow-burning black powder. Then came the steam shovel and the dinky dump cars run on a narrow-gage track, which were big steps forward in promoting speed and economy of operation.

TODAY, automobile dump trucks are used and even the steam shovel is being supplanted by the tractor or crawler shovels run by gasoline or oil engines. Steam-operated hammers drill the rocks for blasting and dynamite takes the place of black powder.

A pneumatic hammer speeds the work of driving spikes into the ties

At the same time that cuts and fills are being made to obtain a uniform grade line, culverts and bridges have to be built, large or small, according to the size of the stream and the maximum amount of rainfall that might be expected during a given time. Particular attention is given to the

The new track is set in the proper position with the aid of a track gage and is being fastened to the ties by trackmen

possibility of eliminating grade crossings.

As the work of preparing the finished subgrade of the road progresses, materials for the construction of the tracks are assembled at the job and then distributed to place. For the track structure of today 22 treated ties are laid for every 39 feet, which is the length of a steel rail. This is followed by the distribution of the steel rails, joint fastenings, bolts, tie plates, spikes, and rail anchors.

THE distribution of track material is quite an undertaking and the manner of handling depends entirely upon local conditions. Where additional tracks are built parallel with existing tracks, the problem is simple, as the material is unloaded right where it is to be used from cars handled by a work engine.

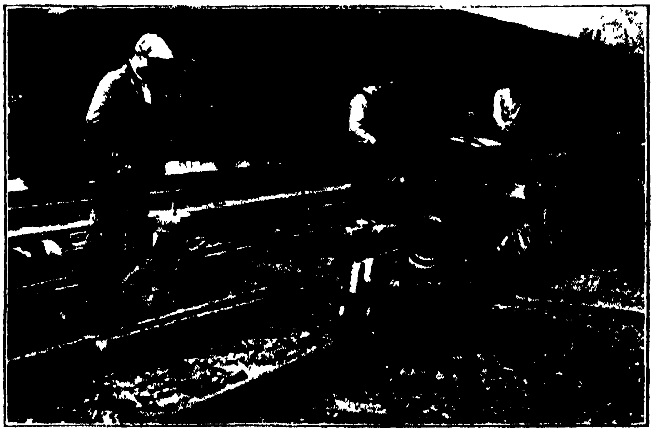
Where the track is on a new line, however, the problem is more difficult. On large jobs a special track-laying outfit is utilized, consisting of a number of flat cars with special power-driven belt or roller conveyors attached to the sides. As the train proceeds to the end of the new track that has been laid, ties and tie plates are placed on one conveyor and carried ahead of the train, where they drop to the ground. The men immediately put these in their proper positions.

On the other conveyor, rail is carried ahead together with the joint fastenings, bolts, and spikes. A small power crane on the head end of the track-laying machine places the rail into position and the trackmen lay the joint bars and spike enough ties to permit the safe passage of the outfit.

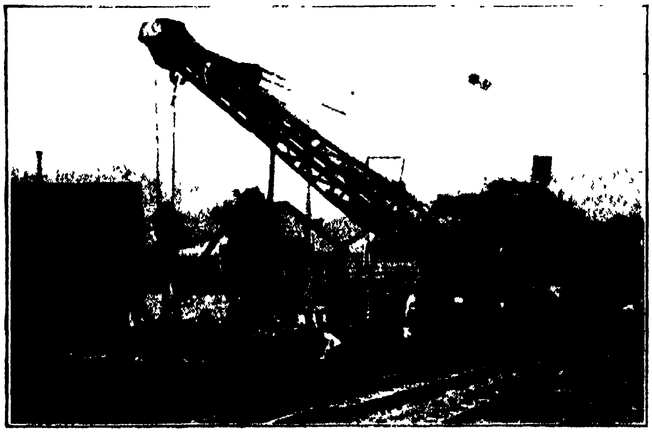
To build one mile of single track railroad, the following material is required: 204 tons of 130 pound (per yard) steel rails; 270 joint fastenings, which with abrasion or rubbing plates weigh 141 pounds each; 5418 tie plates, weighing 16½ pounds each; 48 kegs of track spikes, weighing 200 pounds each; 15 kegs of track bolts, weighing 200 pounds each; 1650 rail anchors, weighing 2½ pounds each, or a total of 4125 pounds; 2979 treated cross ties, size, 7" x 9" x 8½'; 3600 tons of stone ballast. This represents about 89 carloads of material, the cost of which is 22,000 dollars. Labor adds 6000 dollars so our mile costs 28,000 dollars.

After the distribution of material, the ties are evenly spaced with the ends on one side in a straight line. The tie plates are then placed on the top face of the ties, using a gage, so that when the rail is placed on them, the inner or gage side of the rail heads will be exactly four feet 8½ inches apart. This is the distance that has been adopted as standard on all railroads in this country. As the rails are placed, "shims" or spacers are put between the ends to allow for the expansion and

The bonding drill helps to attach the bindings to ensure connections for the electrical currents



When the old rail is removed the ties are trimmed to a level bearing by power-driven adzing machines

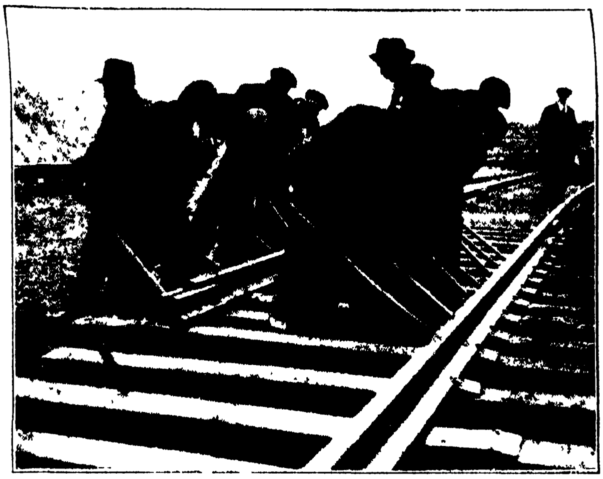


The locomotive crane is seen putting a new rail in position. Rails are now too heavy for hand handling

contraction of the steel, the size of the shim depending upon the temperature at that time.

With the rails set and the joint fastenings applied, one line of rail is spiked into place. The second line is next spiked to the ties conforming to the standard gage. Rail anchors are then placed to hold the expansion space between the rail ends uniformly. Next, the track is aligned according to the stakes set by the field engineer, and it is then ready for the ballasting operation.

CARLOADS of engine cinders are brought in and dumped on the track. The trackmen raise the rails on these cinders until there is a mat 12 to 18 inches thick, extending over the width of the roadbed. Time is now allowed for settlement of the cinders and then when the roadbed has become stabilized, the cinders are "cribbed out" or cleaned out and used to widen the banks of the roadway, and new ballast, of stone, gravel or crushed hard slag, is distributed. The stone ballast is generally used in heavy-traffic high-speed territories. It is necessary to have from six to twelve inches of ballast between the bottom of the ties and the cinder foundation. This takes between 2200 and 3000 cubic yards of ballast, or from 55 to 75 carloads per mile of single track railroad. Ballast is normally handled in drop-bottom cars and as the work train moves ahead, the ballast, released through the bottom doors, drags out practically even with the top of the rails, giving a surplus on which to raise the track. The ballast is generally unevenly placed in this way, however, and the labor of distributing it where it is wanted and needed is quite an item.


A picturesque operation is the placing in exact position of a new rail on the leveled cross ties

A small machine called a "mole" is used to remove ballast between the tracks for cleaning and replacing

Shaping the hillside so as to intercept drainage from the tracks. A locomotive crane is used

This difficulty has been largely overcome by the automatic ballast spreader, a device designed to control the unloading of ballast from railroad hopper cars. It consists of a trough, the bottom of which is equipped with movable plates, permitting openings of the area required to distribute the quantity of stone needed. At each end of the trough are sheet steel plates also equipped with gates for regulating the flow from the end of the pan onto the ballast shoulder. Suspended from each end of the trough is an auxiliary pan called a shaper, which dresses the ballast shoulder to a section. A lever control lowers the distributor when in operation so that it rests on rollers which move forward on the rails. When not in operation, it is raised and carried suspended from the car. It is a great labor-saver.

After the material is distributed, the ballast is impacted under the ties either by hand (using shovel or tamping pick), or mechanically with pneumatic or electrically driven tools. There are two types of electric tampers, one using the direct hammer blow and the other employing vibration, to settle the ballast under the ties. To give a neat appearance to the job, the "berm" or shoulder of ballast outside the tracks (preferably not less than 12 inches wide) is built up uniformly, ditches are cleaned out and made regular and the ballast leveled off and dressed to a definite standard section. In addition to the building of the track structure, a very important item is that of drainage. Wet spots encountered in cuts are tiled and cross-drains installed. Ditches are cut to keep water away from the tracks, and every precaution taken to prevent undermining.

WITH the completion of construction, the work of the engineer is not finished. Wear and tear, increased by the constant demand for greater speed and heavier train loads, needs to be constantly remedied by replacements and repairs, which have to be made without interruption to traffic. This is the maintenance problem.

A slight insight into the magnitude of this important work may be gained from the following statistics covering the seven-year period of 1922–1928, inclusive, for the railroads of the United States:

Roadway and Structures	
Additional track and track material	$ 843,981,000
Heavier rail	242,848,000
Additional ballast	85,879,000
Shops and engine houses	242,470,000
All other improvements	1,385,603,000
Total	$2,800,781,000

The annual program of maintaining a railroad calls first for the renewal or replacement of rails that have become worn. New rail is generally laid out of face that is, uninterruptedly, without patchwork in stretches of from one to five miles on main-line high-speed tracks. Local conditions and the amount of rail to be laid determine the methods to be used.

Let us consider, as an example, the events of one day's work where a large amount of 130-pound rail was laid, replacing 100-pound rail. To organize this work thoroughly the supervisory forces determine from experience just how many men will be needed for each operation of work and how best to get the men to the point of work. Foremen are notified just what their men will be expected to do that day and come prepared with their tools. Further arrangements are made with the transportation department whereby the trackmen can have the uninterrupted use of this track for as long as possible.

Fouled ballast must be cleaned in a special machine, after which it is replaced

Crews have telephones which are used to learn of train movements

Railroad ties by the thousands are stored in piles ready for use in the laying of new track or replacing old ties. Most of the ties are chemically treated

Sufficient men are gathered so that each man can be assigned to a particular duty and to enable him to utilize the full work period. This eliminates the changing of tools and doubling men back and forth on the work. The operations are carried through in the following sequence: 1. Distributing new materials; 2. Pulling spikes; 3. Throwing old rail in about 12 inches from former position; 4. Removing old tie plates; 5. Plugging old spike holes in ties; 6. Adzing surface of ties to give a sound and level bearing for the new tie plates; 7. Placing new tie plates; 8. Setting new rail into place with a rail-laying machine. (This operation is frequently done with various types of cranes, some designed particularly for this work); 9. Placing joint fastenings and tightening two bolts per joint; 10. Spiking every 4th or 5th tie to proper gage; 11. Full bolting the joints; 12. Full spiking all ties; 13. Placing rail anchors to prevent change in the expansion space between rail ends from shifting the rails; 14. Installing bond wires connecting rails in automatic signal territory; 15. Throwing old rail out of track; 16. Disconnecting the old rail; 17. Assembling and classifying old material removed from track.

In this manner it was possible to lay 20,000 feet of rail in one working day with a force of 120 men. With equipment now available, this force could be reduced, since in addition to the machine for setting in rails, there are power-driven adzing machines, power bolt-tighteners, and pneumatic spike-drivers.

Following the laying of the new rails comes the renewal of the cross ties and general rehabilitation of the track. Untreated ties decay rapidly and the average life is but from eight to nine years. With the general use of preservatives injected into the wood to check decay, the life of cross ties has been more than doubled. Ballast becomes fouled and blocks the proper drainage. To restore the drainage and re-establish the uniform grade line or surface of the rail, the ballast is cleaned and the track raised slightly so that fresh ballast may be impacted under the ties.

The rails themselves are subject to heavy wear at the joints because of the hammer blow delivered in the passage of the wheels from one rail to the next, battering out the metal at the joint and also the ballast under the ties. This causes a dip in the rail, referred to as a "low joint," which must be resurfaced and raised periodically. It is this condition that frequently limits the life of rail in main tracks.

More work is required on the maintenance of curves than on straight track, as the centrifugal force of trains passing over the tracks tends to force the weaker points out from the true circular curve, resulting in a bad riding condition. Such curves must frequently be remeasured, calculated,

The new rail is placed as quickly as possible so as not to interfere with the movement of traffic and the old rail is slipped to one side and dismantled later

and thrown back to the true alignment. As a curve can be elevated theoretically correct for only one rate of speed, care must be taken to make that the most suitable for conditions at that particular point. Should the elevation be too great, the center of gravity of the slower moving trains comes too close to the low rail and an excessive portion of the weight of the train is carried on this rail. On the other hand, if there is not sufficient elevation for the speed, the thrust of the train against the outer rail becomes excessive and gives the same feeling to a passenger that one has when riding a "merry-go-round." Either condition gives excessive rail wear and at points on heavier curves in mountainous territories where it is impossible to elevate these curves properly, the life of heavy steel rails is less than a year. By applying a heavy grease or oil to the gage side of the outer or high rail on curves, the frictional wear is greatly reduced and the life of the rail at such points has been greatly extended. Normally, rail should last approximately 10 years in main tracks.

THE maintenance engineer has still another problem—that of providing water for the operation of the locomotives. To do this in many territories in quantities suitable for boiler use is a serious problem. Economies in train operation are made by analyzing water available and installing plants to treat this water so that objectionable foreign substances may be removed before the water is placed in the engine tanks.

Regular and frequent inspections are made of the tracks and their integral parts to detect any flaws in material or workmanship that may develop into safety hazards. The high standard of materials, workmanship, and inspection that is maintained on the railroads is reflected in the freedom from accidents due to defective tracks and other faults that can be avoided by proper attention to important details. In fact, on one major railroad there have been only 1.5 passengers injured in any manner whatsoever per 1,000,000 passenger miles traveled. On this same railroad there has not been a passenger killed in a train accident in over 10 years.

Bridges, buildings, signals, and other structures form a considerable proportion of the property of a railroad, the construction and maintenance of which call for close attention not only to utility but dignified appearance as well. Safety is the first element of consideration, so that no accident shall occur as a result of failure of these structures. "Safety above everything else" guides here as it does in every phase of railroad activity. All of these facilities, adequately supervised and maintained, provide for rapid and safe transportation. Railroad maintenance is a most fascinating subject because changing conditions never allow problems to remain permanently solved.

Rails are elevated to proper position by hand jacks. The tampers then follow, tamping the ballast under the ties to make a firm foundation

Here the hand tampers are elevating the track slightly where necessary. This leveling prolongs the life of track. The track gage is always in use

Winners of the safety blue ribbon of the rail. From left to right, front: Mr. Arthur Williams, President of the American Museum of Safety; Ex-Governor Alfred E. Smith, Trustee; Mr. H. J. Plumhof, Oregon Short Line Railroad Co., winner of the Harriman Gold Medal; Mr. J. P. O'Brien, Oregon-Washington Railroad and Navigation Co., winner of the Harriman silver medal; Mr. Earl V. Develer, Nevada Northern Railroad, winner of the Harriman bronze medal; Mr. R. H. Allison, Cleveland, Cincinnati, Chicago & St. Louis Railway Co., Honorable Mention, Group C; Mr. H. E. Trout, Conemaugh & Black Lick Railroad Co., Honorable Mention, Switching and Terminal Roads. Rear (left), Mr. J. F. Patterson, representing the Long Island Railroad, Honorable Mention, Group A; Mr. W. G. Curren, Staten Island Rapid Transit Railway Co., Honorable Mention in Group B

The Harriman Medals for Rail Safety

THE late Edward H. Harriman was a pioneer in railroad safety and the good work he started on his own railroad system is now, by reason of the Harriman Memorial Medals, carried on long after his death, Mrs. Harriman giving annually a gold, a silver, and a bronze medal for the railroad making the best records in their respective classes. The gold medal (group A) is given to the winning railroad in the "over 10,000,000 locomotive mile class"; the silver medal (group B) to the winning railroad in the "1,000,000 to 10,000,000 locomotive mile class"; while the bronze medal (group C) goes to the winning railroad in the "less than 1,000,000 locomotive mile class." The railroad in each group having the second best record receives an honorable mention. A fourth group "D" has been added this year to take care of switching and terminal railroads, by means of a proper certificate.

THE growth of safety on our railroads is most gratifying and the Harriman Memorial Medals furnish a great stimulus to renewed endeavor. The award is based on the records of the Interstate Commerce Commission, interpreted by the aid of carefully worked out formulae. In 1929, 157 Class I railroads carried 148,379,000 passengers a total of over eight billion passenger-miles, without a single passenger fatality. Deducing an analogy from these figures, one passenger, traveling continuously at a speed of 50 miles an hour for 183 years, could travel 32,000 times around the earth without accidental death.

The medals were awarded at a luncheon on June 24th given by Mr. Arthur Williams, President of the American Museum of Safety, that makes the awards. A very distinguished company of railway men attended. Ex-Governor Alfred E. Smith, a trustee of the Museum, made the presentations. The Committee of Award is as follows: Arthur Williams, Chairman; Samuel O. Dunn, Editor, *Railway Age;* Charles M. Schwab; Hon. Frank McManamy, Chairman Interstate Commerce Commission; Lew R. Palmer, Secretary; F. D. Underwood; and A. A. Hopkins, member of the staff of the SCIENTIFIC AMERICAN and Director of the Museum.

The Harriman Memorial Medals are awarded for safety on railroads

OUR POINT OF VIEW

Machinery and Unemployment

THE blame for unemployment has always been placed, more or less, upon machinery and, in times past, labor has fought its introduction into industries where handwork had been the rule. Even at the present time, there are numbers of pessimists who deprecate the increasing use of machinery and lugubriously point out that it is a Frankenstein monster. Their memory is short; they have been told time and again of the wage earner's gain through machinery, but they seem never to learn. Thus it is necessary to repeat.

Machinery made it possible for one man to do, in 1925, what 3.1 men did in 1914. Thirty years ago, 200 unskilled workers were required to do the work now performed by one steam shovel. In the glass industry, one machine takes the place of 600 skilled glass blowers of a few years ago. In 1920, there was perfected an automatic machine for producing electric light bulbs, that displaced 994 men; and recently this machine has been so improved that it now displaces something like 2000 men. Many other cases are as strikingly significant.

From these figures, it would seem that the pessimists' assumptions are correct. They're not. The number of wage-earners increased 3 percent during the eight years between 1919 and 1927, but—and this is far more important—our production increased 50 percent! With increased industrial prosperity, better wages have been possible and at the same time the worker has been freed from the bondage of labor. Working hours have been cut down: first from a 12-hour day to a 10-hour day, then down to eight hours, and now proposals have been made to make a further cut to six hours. The workingman's week was cut down from six to five and a half days, and it is now proposed to cut it to five.

Better pay and more leisure in which to enjoy the fruits of his work—these are the dividends of the American wage-earner. There is bound to be some temporary unemployment caused by machinery, but this is in an unimportant proportion to the benefits accruing. Nevertheless, certain adjustments are necessary, and it is up to the workingman himself, as well as to industry, to study the question thoroughly so that, as more and more machinery is put into operation, these adjustments may be made with the least loss and an economic balance may be reached.

Sir Arthur Conan Doyle

AFTER an illness of two months, Sir Arthur Conan Doyle died of heart trouble at his home in Sussex, England, on July 7. Famous throughout the world as the creator of that super-detective of fiction, Sherlock Holmes, he was in late years a diligent student and an ardent believer in spiritism. Considering this as a sort of religion, as "infinitely more important than literature, art, politics, or, in fact, anything else in the world," he was annoyed that he was known chiefly for his creation of Sherlock Holmes, and grieved because his friends did not share his unfaltering belief in the spirit world.

Sir Arthur was interested in writing from earliest childhood, having written his first book at the age of six and achieved fame as a story-teller among his early school-mates. His later education was in medicine and he was a practicing physician for several years. His first recognition as an author came when he wrote "Micah Clarke," in 1888, a year after his first volume of Sherlock Holmes; and he won his knighthood with his apologia for the Boer War. The loss of his eldest son in the World War was largely responsible for his devotion to spiritism during his later years.

Sir Arthur was for many years a reader of SCIENTIFIC AMERICAN; and while our opinion relative to psychic, or spiritistic, phenomena, differed from his, we always counted him one of our firmest friends. It may be supposed that the untrammeled imagination which created the greatest detective of fiction "created" much of the spirit world of which he has been called a sort of "Bishop," but that may be countered with the argument that perhaps the practical, analytical mind that worked out Sherlock's crime solutions discovered truths still unknown to many of us. As yet we are not ready to admit either; we are open-minded.

All But the Rattle

EARLY this year it was announced that certain automobile manufacturers would, during 1930, junk old cars up to a value of around 15,000,000 dollars. It was explained that this procedure would have several benefits. First of all the removal of derelicts, still on wheels and a menace to other cars on the road, would prove a blessing to motorists. Manufacturers also said that these rattle-traps undermined their replacement market and their removal would measurably increase sales—a mere matter of 15,000,000 dollars being small compared to the expected sales of 4,000,000 cars at around 3,500,000,000 dollars. Then, too, junking by the manufacturers would decrease the number of old cars that are yearly abandoned along roads to become eye-sores. The plan was heralded as one of the shrewdest moves the automobile industry had ever undertaken.

In the SCIENTIFIC AMERICAN Digest of this issue, our readers are given the first story of how this junking is done. In the Ford plant, the process turns out to be a salvage job in which, with characteristic thoroughness, Henry Ford saves all but the rattle of derelict cars. And although it is said that the salvage per car is 14 dollars, our opinion is that it is more, that the Ford company actually makes money on the proposition.

Other manufacturers no doubt are junking many cars also, but so far we have no details. Those who are not would do well to follow their lead for, aside from all other considerations, the job of salvaging metal in this wasteful country is well worth while and may in time be a vital necessity.

International Affairs

THE INTERNATIONAL BANK

The beginning of the Bank of England during the reign of William III was modest indeed, and the most far-seeing financial genius of that era could not have predicted its future or imagined the tremendous effect it would have on England's and the world's commerce. And today as we listen to the advocates and opponents of the International Bank established to facilitate the settlement of war reparations, we suspect that even the brilliant financial leaders that conceived and boldly sponsored this world bank, and the more conservative bankers who sincerely oppose this new venture, could not gather together and jointly form a reasonably adequate conception of its future effects on world trade and world relations.

That it will be a success, granting reasonably proper management, is a foregone conclusion; that it will become a ponderous financial fly-wheel, steadying world trade and stabilizing foreign exchange, seems probable even to financial laymen; that it will become such a prize that its control will gradually become another bone of

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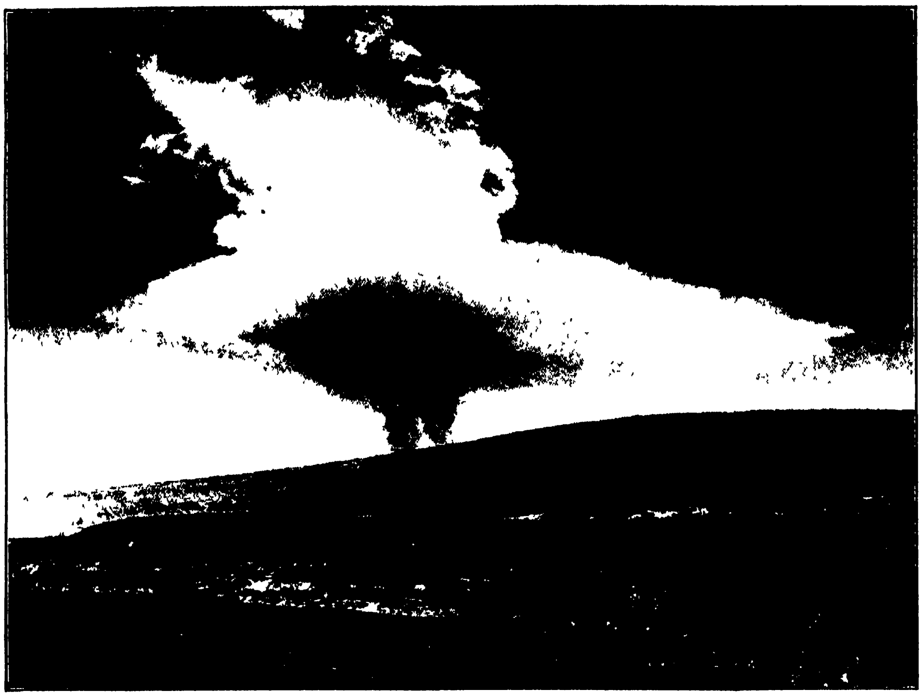


Outburst of Mauna Loa as seen from Kilauea Observatory at 8:30 A.M., May 19, 1916, photographed by Dr. H. O. Wood. This was referred to at the time as the "ballet girl" stage of the eruption. The two legs of the fume column were about two miles apart where the gas rushed up from different places along the southwestern rift of the volcano. A few minutes later they merged into one and the action became stronger. Later the rift opened and gave vent to a lava flow. The distance from the observer is about 25 miles. Kilauea crater in the foreground

Volcanology

By T. A. JAGGAR

Volcanologist U S Geological Survey

What Is Being Done to Make the Observation of the Earth's Internal Fluids an Experimental Science

It may seem strange to many people to learn that the recent campaign suggested by the Scientific American for interesting amateurs in seismology promises to be of great assistance to volcanology. What is volcanology? A tourist, who recently visited Kilauea Volcano in Hawaii while it was sleeping, expressed the popular viewpoint. He saw the observatory and learned of the existence of a volcanologist. "What a cinch," he remarked, "nothing to do but wait for an eruption!"

It had never occurred to him that some of the fundamental processes of volcanology are happening under Iowa at his home town. It had never occurred to him that possibly the recent Mississippi flood with its losses of three hundred millions of dollars is not unrelated to the forces that made the New Madrid earthquake in 1812. The science of the earth is all one thing whereby the continents rise, erosion carves out the valleys, sedimentation fills the mediterranean seas (of which the Gulf of Mexico is one), and the sea bottoms lower. There is a shift of matter under or within the crust of the earth from the heavier regions to the lighter. There is every reason to suppose that this matter is magma, which makes the intrusive rocks at the core of our mountain ranges, or the lavas which pour out at volcanoes.

Volcanology is concerned with the movement of magma. This movement is going on all the time somewhere, rapidly in some places, slowly in other places. It is probably much more important to mankind in its buried movements underground than in its visible movements at volcanoes. These buried movements and shifts of magma lift the mountain ranges at the sources of the Mississippi, lift shore lines in California and Japan, are somehow concerned with the scorching heat under the steam power plant at Geyserville north of San Francisco, and the high temperatures of our deep oil wells, and play their part in the stresses that make big earthquakes.

Science is gradually learning that what is happening under your home town in Montana or Pennsylvania or Louisiana, at a depth of about 35 miles, is equally important with what is happening in the air 30 miles above you. The aviators and the radio people need all possible knowledge of the air. The geologists need all possible knowledge of the earth and the relations of its gases, pastes, and solids. We explore the air with balloons and radiation. The oil people are beginning to explore the earth with echoes, conductivities, magnetic needles, and torsion balances. Volcanology needs the assistance of amateurs to microscope the tiltings and tremblings of vast continents, because without them the job appears to be too big, even for the government.

This makes volcanology something very different from what you thought. Nevertheless, the study of volcanoes and volcanic eruptions is a part of the game. For volcanoes have the advantage that they lie over places where the earth crust is thin, where the ground is hot close to the surface, and where the lava may sometimes actually be seen emerging. In a general way all the active volcanoes of the present day lie at places where there was much greater volcanic activity in

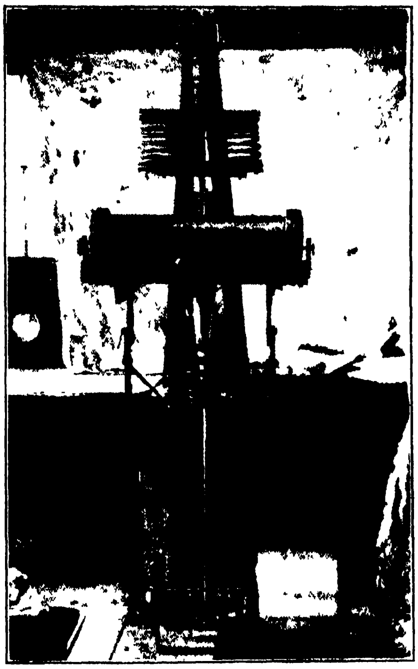
Tertiary time. That is, there are more extinct volcanoes at the volcanic districts of the world than there are live ones. Volcanism today is decadent. In the economy of the earth there have been geologic ages representing big cycles when the crust heated up and cracked, and volcanic magma poured out. The Miocene Tertiary was the last of these.

Decadent volcanism, however, in a volcano belt does not necessarily imply decadent magma underground. The magma underneath a chain of volcanoes may be engaged in processes of intrusion at the present age in a fashion much more lively than that which underlies Iowa and Pennsylvania. If we can make our instruments sensitive enough to show the same kind of motion under both Hawaii and Pennsylvania, but quantitatively greater in Hawaii, we are creating a science of volcanology wherein nobody has to wait for "eruptions." The popular conception of an eruption as something violent, steamy, and explosive is based on a very occasional happening at volcanoes, not at all characteristic of that flow of magma which has done most of the building of the great volcanic lands of the world. Volcanoes show us magma flowing out as lava, and a sensitive pendulum set up on a volcano shows us the ground tilting and trembling as a result of the magma spreading underground as an intrusive, or escaping elsewhere as an outflow. This is what makes a volcano so valuable as a natural laboratory. If we may correlate the physics of the ground with visible flow of magma, we may then go elsewhere and interpret underground flow of magma from measurements of the physics of the ground.

Shaking table with horizontal pendulum seismograph mounted on it, at the Hawaiian Volcano Observatory. This machine is to make artificial horizontal earthquakes with the aid of a lathe chuck. The connecting rod at the lathe has its motion reduced at the two upright levers which rotate on the floor, two steel rollers under the table containing the seismograph. Any quick period required may be given to the apparatus by means of the lathe gears, and the amplitude is made to imitate local earthquakes. A series of tests compares the actual and theoretical magnification of the seismograph as recorded by the pen writing on smoked paper on the drum. Both drum and pendulum are attached to the shaking table. In this way seismographs made in the shop may be calibrated artificially in order to learn how they will behave under earthquake impulses. The shaking table was designed by the geodesist R. M. Wilson

THE original study of volcanoes began with human necessities. Bad eruptions happened at Vesuvius, and the meteorological observatory there turned its scientific work in the direction of keeping a journal of what the volcano was doing. A bad earthquake happened at Naples, and Mallet made some interesting studies of how the buildings were thrown down in relation to a supposed center of bumping underground. The buildings were cracked at right angles to lines extended out in all directions from the center of the shock. If this theory worked, then a building right over the earthquake center, or at the epicenter, ought to be jolted straight up and down, and cracked horizontally. A building far away to the east of a shallow center should be broken vertically along north and south cracks.

If earth movements were as simple as this, the study of earthquake sources would soon become an open book. It was originally thought that steam explosions and collapses underground accounted for earthquakes near volcanoes. Then it was argued that these things are very small, and that volcanic earthquakes are very small. When a very big earthquake happened, like that at Messina, near Mount Etna, it was argued that this could have nothing to do with the volcano, because the volcano did not erupt at the same time. Geological text books have rung the changes on this argument, distinguishing between tectonic and volcanic earthqakes. Tectonic earthquakes are supposed to be crustal movements that have nothing to do with magma, but are occasioned by expansion or contraction or pressure such as are involved in the world forces which build mountain folds and faults in strata. The modern volcanologic viewpoint is that earthquakes occurring at an active volcano may be large or small, shallow or deep, usually occur at faults and not at craters, and represent forces which may be either tectonic or magmatic, according to the way in which those terms are defined. As we have magmatic movements of intrusion and continental balance under the mountains, and as we have crustal movements of pressure, expansion, and contraction under the volcanoes, and as nobody knows what makes an earthquake anyway, the guess of every amateur seismologist is just as good as the next man's.



An experimental seismograph built in the shop of the Hawaiian Volcano Observatory, on designs by the author, for registration of the vertical motion of local earthquakes. The heavy mass weighs 160 pounds and is supported by spiral springs designed for compensation of temperature effects. The registration apparatus is the long, aluminum arm protruding downward, here not shown in its proper relation to the writing pen on the chronograph drum. In operation, the drum is coated with smoked paper and makes one revolution in 30 minutes. When properly placed, the tip of the boom connects with the short arm of the stylus, the pier is mounted on a concrete table in a quiet cellar, and a time-marking apparatus lifts the pen tip once a minute, while the chronograph drum moves along on its spindle. The action of the earth lifts the pier at a horizontal hinge line around the heavy mass acting as a center of percussion

Between 1891 and 1923 there grew up in Japan a science of field seismology led by Dr. F. Omori. Japan is a land of earthquakes and volcanoes mixed together. Dr. Omori devoted himself at first to devising seismographs and spreading them among the meteorological stations of Japan. He measured thousands of earthquakes. Very exceptional earthquakes were accompanied by big fault cracks, the sides of which moved up or down or sideways. Geologists have the habit of pouncing joyfully on these exceptional ones and concluding that the accumulated stress in the rock at the side of the fault crack was released when the fault gave way and that this yielding to accumulated stress is the usual cause of great earthquakes. Oldham, a distinguished geologist of India, has combated this notion with the argument that the stress is developed very suddenly in the deep region. Omari found out that earthquakes are far from simple, that big ones may occur in the midst of a big volcanic eruption, or near a big volcano not in eruption, or in a district not recently volcanic at all, and that some of these earthquakes have obvious fault movements and that some show no obvious faults at all.

This last fact had been observed by Oldham in India, by the Americans at the New Madrid earthquake of 1812, and by Major Dutton at the Charleston earthquake of 1886. Omori came more and more during the last fifteen years of his life to devote himself to the study of volcanoes, for he saw that there is an infinite series of earthquakes, small to great, somehow related to magma. He and his successors have learned in Japan that both volcanic eruptions and strong earthquakes are accompanied by topographic changes of elevation of the land. In using the expression "volcanic eruption," in this sense, the reader should remember that flow of magma is meant. A big gush of explosion with ash and steam is not essential to a volcanic eruption, and a retirement of lava straight downward under a volcano crater might be accompanied by a very important "eruption" or flow of magma. In this case the eruption would be a flow of lava from a rift under the sea which nobody would notice, unless the volcanologists were using their wits. And seven tenths of the geology of the earth is under the sea.

In 1911 an observatory was started at Kilauea Volcano in Hawaii, which the writer has had the honor to operate. This also was influenced by the humane viewpoint, for the terrible disasters at St. Pierre, Vesuvius, Jamaica, Messina, Etna, and Costa Rica had induced donors to create an endowment in the Massachusetts Institute of Technology for geophysical study that might lead to amelioration of conditions in earthquake lands. The observatory was started by the Massachusetts Institute and carried on thereafter by the Hawaiian Volcano Research Association assisted by the government. The Hawaiian Volcano Observatory kept a diary of everything that happened at the Hawaiian volcanoes and measured everything that was measurable within the limit of funds at its command. The volcanoes were mapped, the Kilauea lava pit was mapped again and again as its lava topography changed, leveling circuits were occupied repeatedly, a seismograph station was set up at the crater and afterwards supplemented with other stations about the island, and experiments were inaugurated.

Southeastern corner of the lava lake of Kilauea, March 19, 1921, at 2 P.M. A cauldron sink-hole against the pressure ridge at the edge of the pit had formed, and the lava was rushing toward this place and being sucked down in the convectional circulation. Single jets of lava shot up by the escaping gas were 40 feet high. The torrent on the right is rushing into the cauldron, and a rampart is being built up in the background. This was a crisis of high rising when the fire-pit overflowed and the gas pressure was enormous. Photo by the author

The experiments proved, by the use of different kinds of thermometers and pyrometers, that the liquid lava grows hotter from below upward, just as it grows more foamy from below upward, as the bubbling gases are released from solution in the melt beneath. This melt is very dense under pressure down deep, and as the gases escape to the bubble form under release of pressure, they react with each other and with air to produce combustion of hydrogen, carbon monoxide, and sulfur gases along with rise of temperature. A lava eruption is thus a heating expansion of slag foam. This was a new idea. When this basaltic foam spreads out in the crater or beyond, in contact with atmospheric temperatures, it freezes, and in the crater pits it is engaged in an incessant struggle with congealing cold.

The topography of the top of the live lava column in Kilauea Crater becomes diversified into crags, floors, and lakes of lava. A series of experiments with steel pipes was initiated whereby it appeared that the liquid lakes are only 40 or 50 feet deep, with wells and tunnels feeding them. These wells and tunnels are not in the solid rock of the mountain, but form a honeycomb in the partially hardened lava that underlies the crags and floors. This hardened lava column is red hot and pasty, with tubes leading up through it to the shallow saucers of foamy lava on its top, while somewhere down deep both the pasty lava and the liquid merge into the very stiff primitive rising lava, under great pressure, and with the gases in complete solution.

This primitive stuff nobody has ever seen. When it is released from pressure to froth into the region of man's ken, it changes, heats, gassifies, and oxidizes to a glassy foam mixed with burning gas which may be very unlike the mother magma. The partially congealed refuse of this makes the lake bottoms, crags, and floors, and this paste rises and falls majestically as the main lava column in the pit, with the liquid lakes rising and falling at about the same rate on top of it, but with small differences between the two from day to day. The discovery of the difference between bench lava and liquid lava was another new idea.

With all this rising and falling, measurable with reference to the bench marks on the edge of the crater, it became of interest after 15 years of work to see how the curve of up and down compares with past curves. It was well known from the work of the devoted missionary Coan in the middle of the 19th Century, that Mauna Loa had more than a dozen outpourings of lava in great streams sometimes 60 miles long, and that Kilauea had lava in its pit most of the time. There had been some hint of a cycle about nine years long. The Hawaiian Volcano Observatory uncovered a cycle between 1913 and 1924, eleven years long, with the pit very deep and inactive at both ends of this time. Moreover, the lava rose from 1913 to 1919, sank from 1919 to 1924, and crashed down with a great engulfment of the walls of the pit in the last named year. Along with this culmination of 1919, Mauna Loa showed increasing eruptions in sympathy with the Kilauea cycle. The 11-year period was compared with what is known of the 19th Century, and it was discovered that the high levels agree very well with years of maximum sunspots, and that 12 cycles of 11.1 years each from 1790 to 1924 agree better with the facts than the older conception of a nine-year cycle. It happens, too, that this is just the sunspot average.

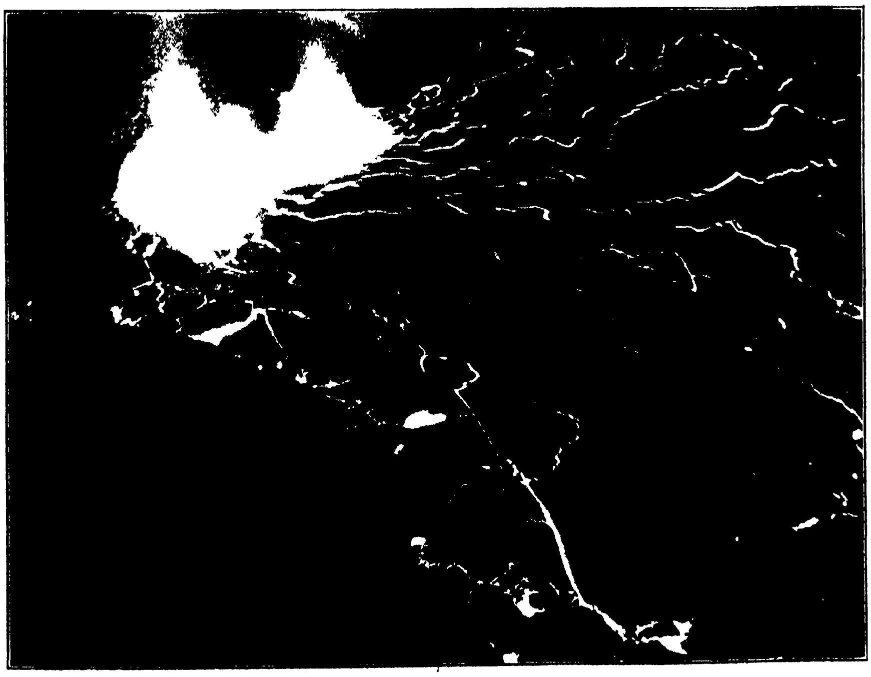
THE facts indicate that Mauna Loa and Kilauea alternate somewhat, and that there is a greater cycle 134 years long during which the lava of the entire Hawaiian system rose to a culmination of outpouring about 1855, declining thereafter until 1924, when there was an explosive eruption at Kilauea, and very probably a submarine lava flow under the deep sea off to the east. The supercycle had followed an explosive eruption at Kilauea in 1790, and this larger ininterval of something like 130 years corresponds to similar periods in Japan and Italy elapsing between great earthquakes or great volcanic eruptions at the same place. It is reasonable that magma should move in waves of accumulated gas pressure and release, and also there may be astronomical controls in these cycles.

The volcano seismographs at Kilauea have indicated thousands of earthquakes, and by comparing the records with those of the secondary stations and with the reports of felt earthquakes at habitations, it has been possible to locate groups of earthquake centers. These have often corresponded fairly well with known volcanic fissures or faults, sometimes when the fissures in question broke into eruption and gave vent to lava flows. The earthquake centers rarely correspond with summit craters. Often the earthquakes, registered by a pendulum and a pen writing on smoked paper, are accompanied by a swinging off of the pendulum to a new position after the earthquake. This means that the ground has tilted during the earthquake. These tilting movements have been compared with changes of level of the country as proved by geodetic levelings. It has been discovered that Kilauea Mountain rose more than two feet while the lava was rising in the seven years following 1913, and sank by a similar amount during the explosive engulfment of 1924. And the pendulums indicated the actual months of maximum tilting, as corresponding with times of maximum lava pressure and lava withdrawal.

All of this means that land underlaid by magma is subject to swelling and shrinking forces, and it will prove increasingly fascinating to harness these forces with simple instruments and volunteer observers until the centers of motion, and the relative motions of different places, have been discovered. To anyone who has worked where these motions are rapid and strong, as on Hawaii, it appears that the geographical facts of distribution of motion, in relation to volcanic centers, are much more needed than precision work at one place. That is where the amateur and volunteer will come in, and consequently the simplification of instruments appears to the writer to be the most important need of seismology.

What is the use of volcanology? On the answer to this depends in part how we ought to attack the science. If we are interested in theories of the earth's internal elasticity, of its heat, of its gases and radioactivity, and care nothing for the effects of volcanic eruptions and earthquakes on mankind and his cities, we should devote ourselves wholly to precision laboratories with only minor attention to geography. But there comes into the argument the Mississippi flood, the devastating tidal waves, the failure of gigantic engineering works at times of great earthquakes, and destruction of cities such as St. Pierre. If a great insurance company were to create a research laboratory of volcanology to solve company problems, what would they demand? They would certainly demand, first, attention to engineering and to geography. In other words, the human need for a science of eruption, of deformation, of sedimentation, and of erosion calls for field laboratories eternally measuring by observatory methods the quantitative aspects of those processes. All the processes are tied together as affecting the pipe lines, dams, railways, farms, cities, roads, bridges, wharves, levees, aqueducts, wires, harbors, and fills on which human beings have spent billions of dollars.

AS it is, the science of volcanology, quite apart from volcanoes, is the forerunner of a new science of the earth, which at this moment in America is being greatly assisted by the new flood-relief measures carried out by the government on a gigantic scale on all the rivers of the United States. Probably few people realize that this study of earth process is the pioneer of a science of geonomy the workers of which will be geonomers living at observatories and actuated by the same spirit as astronomers. Erosion science has hardly been touched, yet mountain canyons are falling down all the time and their wreckage is being swept to the ocean. It is a marvelous opportunity for new measurements and new instruments. Mountains are heaving up, continents are tilting, flood plains are shifting, waters are muddying and clearing, bays and lakes are filling, the bedrock is shaking and, under all, the magma is welling under the crust of the earth, warming the hot springs, heaving the hills, and accounting for a hundred unmeasured phenomena up and down the Pacific Coast and Alaska, as well as in Arkansas, Virginia, and the Adirondacks. With simplified instruments and hundreds of amateurs, we may expect the natural history of the earth to take a new lease on life.



Night photograph of a live lava lake in the bottom of Halemaumau pit at Kilauea Volcano, July 25, 1929, at 9 P.M. It shows the bright lines on the surface of a crusted pool of lava, and the great luminosity of fountains flaming during an eruption in which a fountaining lava grotto similar to the one on the front cover furnished the molten matter which sweeps over the pool

Why Stars Twinkle

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

PROBABLY the first thing that many of us learned about the stars was that they twinkle, and the fact is obvious enough to deserve its place in the nursery classic. But does any grown-up, except perhaps an occasional minor poet, notice the phenomenon—and in particular what have the astronomers to say about it?

As a matter of fact the professional observer habitually scans the twinkling lights of heaven as he walks toward his telescope and the more they twinkle the less is he pleased. Whenever the brightest stars, though low down in the sky, twinkle but lazily and those higher up shine steadily, he anticipates a good night's work. But on our clear snappy winter nights, when the wind roars overhead and the brilliant stars are dancing and flickering, he hopes for little or nothing; and after one glance through his telescope he may even shut up shop and go home to bed.

For the twinkling of the stars is the best test that the unaided eye can make of what is technically called the "seeing" that is, of the state of the air through which we must look. The late Professor Young, translating literally and with his characteristic jocular humor from some French book, used to repeat to his students, "The earth's atmosphere is the astronomer's black beast" and a *bete noire* it surely is.

FORGET for a moment the clouds, fogs, smoke, and rain which so often blot out the heavens altogether and think of the limitations which even clear skies impose. Could we astronomers but live without breathing, and escape for our working time to an airless world, our lot as observers would be a happy one. With nothing above us to scatter the sunlight and veil the heavens with blue sky, we could see the stars as well by day as by night—and photograph them too. The solar corona could be observed at any time merely by hiding the sun's disk by a suitable screen placed in front of our telescope, instead of waiting years for a total eclipse. Best of all, our spectroscopes could get at the far ultra-violet parts of the spectrum of the sun and stars, which is utterly and hopelessly cut off by the absorption of light of this sort in the upper atmosphere and which probably contains more things of astrophysical interest than all the parts that we actually can observe.

But let all this pass again and write it off as hopeless, even to dream of. Even so, the cloudless sky still is too often our worst enemy. The atmosphere is lamentably far from being optically satisfactory to look through. It refracts light, which would not be a serious matter if it were only homogeneous but this it never is. The air is full of streaks and patches of different temperature and unequal densities, which are carried along by the wind and churned into a still more turbulent complexity wherever the wind is puffy or where winds blow in different directions at different levels. Large scale disturbances of this sort are often directly visible as dust whirls near the ground, or as the long parallel streaks of cloud in the "mackerel sky." They are all too familiar to the airman, too, as the "bumps" which make flying uncomfortable and occasionally even dangerous.

THESE larger irregularities are not always present, fortunately for the astronomer, but the smaller ones are always there and make trouble enough. Looking through them is, on a smaller scale, like looking up through running water or the rippled surface of a pool. Every streak of denser or thinner air, like the crest or trough of a ripple, acts as a lens would do to concentrate or spread out two originally parallel rays of a star's light. If only the starlight was strong enough, said Young many years ago, we should see on a white surface illuminated by it a moving pattern of lighter and darker patches resembling that formed on the sandy bottom of a pond when the sun shines on its rippled surface.

This prediction can be verified by anyone with keen eyesight who takes the trouble to find a dark room with a window free from all disturbance from artificial lights and let the light of Sirius come through the window (stopped down to a couple of feet square) and fall on a white sheet a dozen or more feet away. Until his eyes are fully adapted to the pitchy darkness, which will take 15 minutes or more, he will see very little. But then he will find that the patch of starlight on the screen is distinctly visible, even for considerably fainter stars, while for Sirius it is bright enough to exhibit the shifting lights and darker patches which Young predicted. Now imagine an observer looking through a hole in this screen. As the brighter or fainter patches pass over it he will see the star increase or diminish in brightness. In other words it will *twinkle* and of course it will do so just the same if the screen is not there.

We see now, not only why the stars twinkle, but why their twinkling gives really valuable information to the astronomer regarding the state of the air much better, indeed, than could be obtained by looking, even with the sharpest eyes, at a screen illuminated only by the feeble light of Sirius. It is clear, too, why stars high in the sky twinkle less than those lower down, for the rays of the first traverse a smaller thickness of air and so pick up less trouble.

Why bright stars seem to twinkle more than faint ones is not so obvious, the explanation being that rapid changes in the fainter object are less conspicuous to the eye than in the brighter one.

NO explanation is needed why the stars twinkle more on a windy night than on a calm one. Indeed, when they twinkle violently on a night when there is a calm or a light breeze at the ground it is very probable that it is blowing half a gale higher up.

It is obvious, too, why terrestrial lights usually twinkle when seen at a distance of some miles, especially when seen through a wind or across ground from which heated air is rising, or from the deck of a moving steamer—as the writer has this moment seen the lights of a Greek seaport, twinkling furiously.

The planets do not twinkle, at least under any ordinary circumstances—which affords one of the simplest rough-and-ready tests by which the novice may distinguish them from the stars. The reason again is simple. The planets, unlike the stars, show disks of considerable angular diameter. The lines along which light enters our eye from different parts of the planet diverge when followed backward. The rays from opposite sides of Jupiter, for example, which enter the same eye were more than a foot apart a mile farther back on their course. If we could isolate the light from any one small portion of the planet it doubtless would twinkle, but the different parts do not keep step in their twinkling and so the whole amount of light received by the eye does not change perceptibly. That this is the true explanation is shown by certain exceptions which prove the rule. Mercury, which shows a small disk, often twinkles, and so may the larger planets when seen near the horizon through turbulent air.

A star, when it twinkles, changes not merely its brightness but its color, especially if it is at a low altitude. How great these changes are is not generally realized because they usually happen too fast for the eye to follow. A simple device reveals them. Look at the star with an ordinary field glass and swing the glass rapidly with a sort of conical motion (a thing easier to do than to describe in a few words) so that the star appears to follow a rough circle within the field of view. If the motion is fast enough the luminous point will appear to be drawn out by the persistence of vision into a curving line of light. A star which is not twinkling gives a uniform line but one which is, shows a surprising variation both in the intensity and color of the light. On a night of bad seeing the luminous line is beaded with patches of brilliant color, almost like the flashes from a diamond. When the glass is held still the successive changes, which may follow one another 20 times a second or more, become partially though not wholly fused into the familiar flickering image.

THIS remarkable and beautiful phenomenon was first explained by the Belgian, Montigny, more than 70 years ago, but it still is not as widely understood as it ought to be, and the writer owes the account which follows to the excellent Italian treatise of Professor Armelline of the University of Rome.

Owing to the refraction of light in the atmosphere the rays of starlight which traverse it are not quite straight, but are curved slightly downward as they go deeper. Blue and violet light are refracted more than red and yellow, so that the corresponding rays are more curved. If, then, we have a streak of air high up which, for example, acts as a convex lens, the red and blue rays, though both concentrated into bright patches of starlight on the earth's surface, will pursue paths of slightly different curvature and will not reach the earth in the same spot. If, then, we could see the patterns cast on the surface by the red and blue light separately, we would find them very similar in design but shifted laterally with respect to one another.

FOR a star in the zenith, indeed, the rays would come down straight and there would be no shift, but in all the cases the red and blue patterns would be out of register by an amount increasing as the star's altitude diminished; and also of course the higher in the air were the regions which produced the pattern. The actual light pattern would be very complex, composed of patterns of all colors, some more out of register than others. But it is evident that, from point to point in it, any given color might happen to be intensified, and any other (not too nearly like the first) might be weakened. The resulting pattern would therefore be irregularly and sometimes strongly colored and as it drifted past an observer's eye the star would appear to change in color as well as in brightness. There can be no doubt that this is the true explanation. It is confirmed by the fact that conspicuous changes of color appear only in stars at a low altitude, for which the curvature of the rays is greatest.

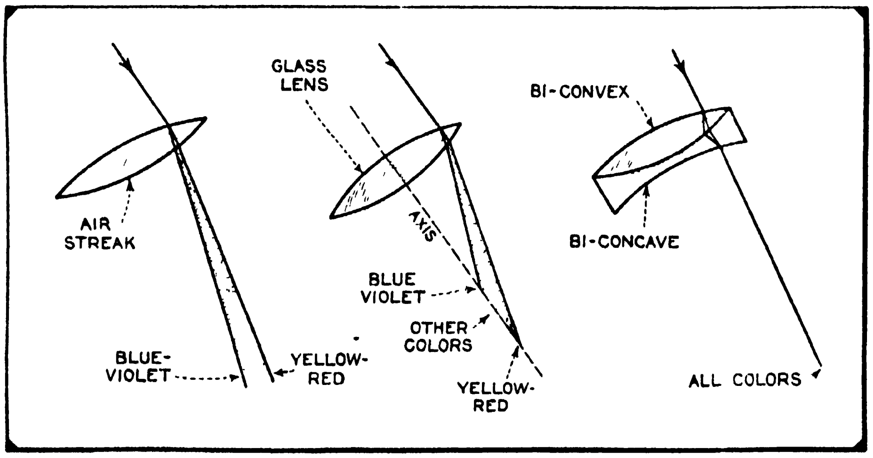
When viewed with a telescope, especially a large one, the appearance of a twinkling star differs greatly from that which it presents to the eye. The changes in brightness and color are far less conspicuous, but the star images at times of modest disturbance appear to shift and dance irregularly about. When the seeing is really bad the image is distorted and refuses to come to any sharp focus, but is continually "boiling" and shifting; and sometimes it "explodes" into a diffused mass of considerable size.

All these effects again are readily intelligible. The rays which strike different parts of the objective of the telescope and are brought by it to one focus have traversed different paths within the atmosphere, so that some of them may be weakened at any given moment and others strengthened. The changes in brightness of the integrated image are therefore pretty well ironed out, and the same is true of the color.

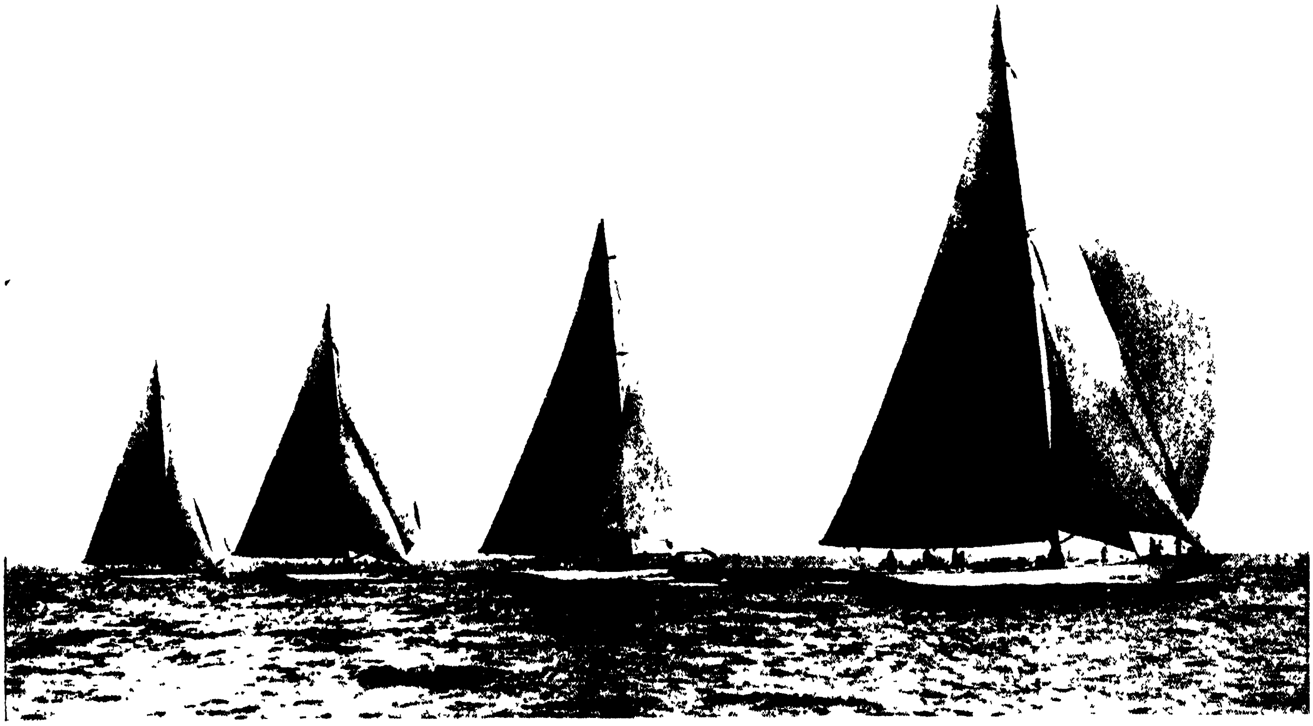
On the other hand the small lateral deflections of the direction of the ray as a whole, which are usually quite imperceptible through the unaided eye, become visible and often conspicuous when magnified. When the disturbance pattern in the air is on a large scale all the rays which enter the objective of the telescope may be deviated in the same general direction, and as this changes from moment to moment the image dances. When the pattern is small the rays entering different parts of the objective are deviated in different ways and the image refuses to come to any good focus but boils, and in particularly bad moments it explodes. This sort of trouble evidently should be most frequent with large telescopes, and so it actually is found to be.

ATMOSPHERIC disturbances of all these kinds are among the worst defects that can afflict an observing station. It is no wonder then that when a great observatory is being planned careful tests of seeing are made at many proposed sights and often enough to get a good average representative of conditions the year around. For work of this importance a telescope of several inches aperture in the hands of an experienced observer is necessary. But in the preliminary reconnaissance which selects the places for further testing the simple observation with the naked eye of the twinkling of the stars should suffice to exclude many hopeless situations and pick those which are more promising.

So the modern astronomer who sees the little stars twinkling and the brighter ones still more—moves on, fearing that, should he set up his telescope in so ill-favored a spot, he might find it useless for the greater part of the time, and be left "wondering" what the stars "are," rather than finding out. *In the Gulf of Corinth.*



A streak of denser air high aloft (see left hand sketch, which is of couse diagrammatic) affects the light rays arriving from space in the same way as a simple bi-convex, non-achromatic lens (middle sketch). In the case of the glass lens we can virtually balance out this "chromatic aberration" by adding a second lens (third sketch), but there is no convenient way of capping a dense air streak with a rarefied one, even from an airplane, and this is why the astronomer often must "go home to bed," as Dr. Russell says in the text



The candidates for the defence of the America's Cup. *Right to left:* *Weetamoe* (1); *Enterprise* (4); *Yankee* (2); and *Whirlwind* (3). The defender will be selected in the latter part of August after a series of official trial races

The America's Cup Defenders

By HERBERT L. STONE

[Editor, *Yachting*

WHEN the little schooner yacht *America* fared forth across the Atlantic 79 years ago this summer to fling down the gage of defiance to British yachtsmen it is safe to say that not one of the adventurous spirits who backed that valiant effort ever foresaw that the insignificant cup which now bears the name of the vessel that won it would one day stand for the supremacy of speed upon the waters; or that many millions of dollars would be spent in any single attempt to retain it in this country.

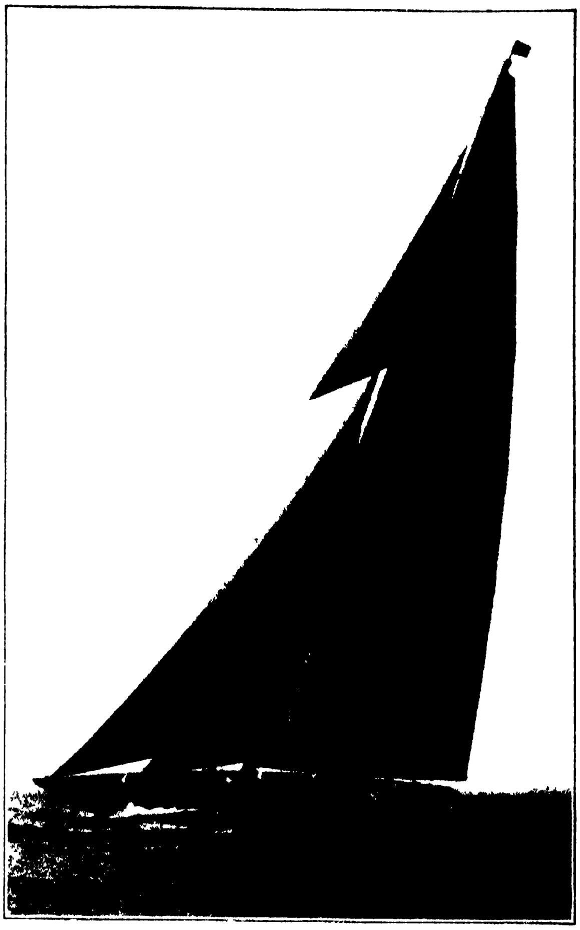
For 79 years, during which 13 hard-fought races, or matches, have been sailed for this particular bit of silverware, the cup has never left our shores; and to meet Sir Thomas Lipton's fifth challenge this year we have made, perhaps, the most elaborate preparations for its defence in September that have ever been seen in any yacht race. For we have built no less than four candidates for the defence, the cost of which, together with the expenses of campaigning them throughout the season, will total between three and four million dollars. And this for a cup the intrinsic value of which was originally 100 guineas, or about 500 dollars

The schooner *America*, which was built in New York at the foot of East 12th Street, after a model by George Steers, for a syndicate of New York Yacht Club members headed by Commodore John C. Stevens, was, as far as the records show, the first American yacht to cross the Atlantic for the purpose of racing in a foreign country. It had been suggested that, in connection with a great international exhibition to be held in England in 1851, it would be "eminently fitting" if America send over a yacht to sail in the races to be held in English waters that year. It was also intimated that plenty of matches could be secured in the event of a yacht being sent. So the *America* was built and sailed across in the spring and early summer of that year. She was a schooner of moderate size, being 90 feet long on the water and 101 feet, 9 inches over all, her model following closely that of a smart pilot schooner turned out by George Steers a few years earlier. Her rig was distinctly American, with excessively raking masts, a single big jib, and a loose-footed foresail.

But when the *America* reached British waters she found it exceedingly difficult to arrange for the promised matches. Her crew made the mistake, as she sailed up the Solent towards the Royal Yacht Squadron on her arrival, of tackling the "crack" English cutter *Lavrock* in an impromptu brush, during which she beat this boat so handily in a beat to windward that other British yachtsmen seemed loath to sail a race with the stranger. English yachtsmen were most hospitable, but they showed a strong disinclination to arrange a special match with the *America*. Finally, Commodore Stevens, despairing of getting a race, posted a challenge to sail the *America* in a match against any British vessel whatsoever for any sum up to 50,000 dollars. This had no effect in bringing about the desired meeting, but the officers of the Royal Yacht Squadron informed Commodore Stevens that the *America* could race in the regular open regatta of the Squadron on August 22nd, for which all of their yachts were eligible, the race to be sailed without time allowance. The prize was to be a trophy, put up by the Club, valued at one hundred guineas.

This was hardly what the crew of the *America* wanted, but they decided to start, the course being around the Isle of Wight, a distance of about 53 miles. There were 15 starters in this race, all British except the *America*, and ranging in size from 47 tons to 392 tons, the latter being the big three-masted schooner *Brilliant*. The race was sailed in a variety of light, fluky winds, and with strong tides to contend with, but the *America* won rather handsomely. The original records of that race are not clear as to the time by which *America* finished ahead of the second boat, but the New York Yacht Club records give it as 18 minutes.

The Cup thus represented almost the sole proceeds of that summer adventure, and some six years later, or in 1857, it was turned over to the New York Yacht Club by the syndicate which built the *America*, to be put up for international competition, and has been held by that organization ever since. The race this year marks the 14th attempt to capture it, all the challenges coming from Great Britain, with the exception of two from Canada. Also, this last challenge by Sir Thomas Lipton makes the fifth attempt the Irish baronet has made to "lift the mug," as he expresses it, the first having been in 1899, just 31 years ago. All of his yachts have borne the name of the four-leafed clover so dear to Irish hearts.


The Shamrock V, **Lipton's Cup challenger**

OF late years the cost of building and campaigning a yacht for Cup defence has become so great that it has become a matter for syndicates to handle, rather than individuals, as was the case with most of the Cup yachts up to the time of the *Vigilant*, in 1893. So when this last challenge was received, those interested in seeing a proper defence assured started to form syndicates for the building of candidates to meet the *Shamrock V*. In a short space of time no less than four such syndicates were formed, and work on the design and construction of the four yachts went merrily forward. It is estimated that to build and race a Cup yacht of this size costs between 700,000 and 800,000 dollars.

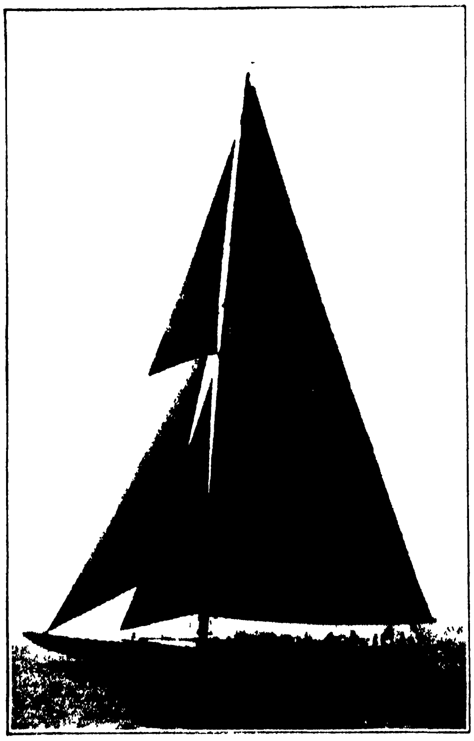
In the matter of design we found ourselves confronted with a situation which was somewhat unique, inasmuch as none of our active naval architects had ever designed an America's Cup yacht, and few of them had turned out a racing cutter of the size called for. "Nat" Herreshoff, of Bristol, and William Gardner, who created the two candidates for the race of 1920, had both retired and were out of the picture. So the four syndicates turned to three of our younger designers, and to Clinton H. Crane, who is no longer pursuing naval architecture as a profession, but who recently turned out several smaller successful yachts as an avocation.

Towards the race this year the New York Yacht Club displayed a very liberal attitude and suggested to Sir Thomas that instead of his building to a specified water-line length, as in the past, and their meeting him with a boat of the same water-line length, that he build to one of the regular classes of the New York Yacht Club, in which event we would build to the same class and race him boat for boat, without time allowance. Heretofore the yachts have raced with time allowance, so that sometimes the first boat to finish did not turn out to be the winner, which was often unsatisfactory and confusing to the general public.

Deck view of the *Whirlwind*. She is a double ender with canoe stern. This is the first time this form of stern has been used in an America's Cup yacht

SIR THOMAS accepted and elected to build to Class J, or 76-feet rating. Therefore, all of our boats were built to this rating also. This 76-feet rating does not mean that the boats are of this length, but that the resulting measurement derived from a formula taking into consideration length, displacement, and sail area will be 76 feet. As a matter of fact, the various yachts built for this year's race vary in water-line length from about 80 to 86 feet, and in tonnage (displacement) from 128 to 158 tons, all with approximately the same sail area. This allows plenty of scope in design to assure that the boats would not be of exactly the same form and dimensions. The over-all length varies from 120 to 130 feet in our four candidates. With the modern Marconi, or jib-headed rigs that modern yachts carry, all of the boats have extremely long, hollow masts, varying in height from 162 feet to 168 feet. As these are made in one piece, with no fidded topmasts, as in the case of the older yachts, it means that particular attention must be given to proper staying of the masts in order to keep these long slender spars in the boat, and many fears are being expressed as to the possibility of the masts giving way in a hard breeze and jump of sea, such as are likely to be met off Newport in September.

Another forward step this year in these defenders is that the hulls are all built to Lloyd's scantling requirements, which means very substantial construction as compared to the defenders of recent years, in which every sacrifice



Weetamoe. **Mechanical appliances are used for handling halliards and sheets**

was made to lightness. This practice went so far that it was considered unsafe to race in a wind which to the early Cup boats would have been only a whole-sail breeze, and resulted in one of the races of 1920 being called off in a wind of only some 25 miles-an-hour strength. Also, it means less of a handicap to the challenger, for as our boats are built to the same scantling (or frame) dimensions, they have to be as substantial as the *Shamrock V*, which, to race, must sail across the Atlantic on her own bottom.

ANOTHER feature of modern yachts built for the defence of the Cup that marks a great departure from previous practice is in the mechanical contrivances for handling gear. Below decks, on all the boats built for this race, no accommodations of any kind for the crew are to be found. The entire personnel of each yacht, from 22 to 24 men, is berthed and boarded on a large tender, which follows the yacht to which she is attached to the various ports where she may base. This leaves room below for the stowage of various light sails or "kites" which these boats must carry to make the most out of every vagary of the wind, and for the many winches and drum hoists for handling halliards and sheets. The halliards for all except the lightest sails lead to mechanical hoists below, while the main sheets and some of the headsail sheets also are led to winches below, where a gang of men takes in on them or slacks them off on signal from deck. This is a far cry from the traditional method of all-hands tailing on to sheet and halliard to hoist or trim sail, as in the days of the *America*, and all of those yachts which followed her in the quest for the Cup up to quite recent times

The four yachts built for this year's defence are the *Weetamoe*, *Enterprise*, *Yankee*, and *Whirlwind*. A comparative table showing the principal dimensions of these boats, and of the challenger, *Shamrock V*, is given, and the details of ownership and design follow.

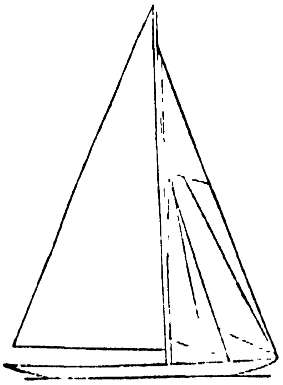
Weetamoe, Racing Number 1. Designed by Clinton H. Crane. Built by the Herreshoff Mfg. Co., Bristol, R. I. She is for a syndicate organized by J. P. Morgan and Junius S. Morgan, Jr., the other members being Henry Walters, Cornelius Vanderbilt, Arthur Curtiss James, Gerard B. Lambert, and George T. Bowdoin. Former Commodore George Nichols is managing owner and skipper and will sail the yacht throughout the season. With him on the quarter deck are John Parkinson, Robert N. Bavier, A. H. Eustis, and Junius S. Morgan

Yankee, Number 2. Designed by Frank C. Paine, a son of General Charles J. Paine, who owned or managed the Cup defenders *Puritan*, *Mayflower* and *Volunteer* in 1885-6-7. Built by George Lawley & Son, Boston, for a Boston syndicate composed of John T. Lawrence, Chandler Hovey, and Frank C. Paine. The first named is syndicate manager, and in the afterguard with him are Raymond Hunt, Frank Paine, Chandler Hovey, and, on occasion, Charles Francis Adams, Secretary of the Navy.

Whirlwind, Number 3. Designed by by L. Francis Herreshoff, son of the famous Nathaniel Herreshoff, the "Wizard of Bristol," who designed all our previous Cup defenders since 1893. Built by George Lawley & Son, Boston, for a syndicate organized by Paul Hammond and Landon K. Thorne, of New York, who will sail her in her races, with Adrian Iselin, II, assisting.

Enterprise, Number 4. Designed by W. Starling Burgess, son of Edward Burgess who turned out the successful defenders *Puritan*, *Mayflower*, and *Volunteer* mentioned above. Built by Herreshoff Mfg. Co., Bristol, R. I. She is owned by a syndicate headed by Harold S. Vanderbilt, and consisting, beside himself, of W. W. Aldrich, Commodore Vincent Astor, George F. Baker, Floyd L. Carlisle, Ogden L. Mills, E. Walter Clark, and George Whitney. Harold Vanderbilt is her skipper, and sailing with him are C. Sherman Hoyt, C. F. Havemeyer, W. W. Aldrich, and the designer, Starling Burgess.

All of these four yachts, excepting the *Whirlwind*, are built with bronze plating over steel frames. The decks are of wood. The *Whirlwind* is of composite construction, with a double planking of wood over steel frames. This latter boat is a double-ender, the ends of the others being of moderate length for a modern yacht and of conventional form. Each of the defenders is fitted with a small centerboard, excepting the *Whirlwind*.



Sail plan of a modern Cup defender

WHILE the four American Cup candidates have been racing since June, the actual defender will not be named until after a series of official trial races to be sailed off Newport, over the Cup course, between August 20th and 30th. After this selection is made, the following two weeks will be spent polishing up the successful candidate to get her in the pink of condition to meet *Shamrock V* in a series consisting of the best four races out of seven, starting September 13th, nine miles southeast of Brenton Reef Lightvessel. And, then, may the best boat win!

	Weetamoe	*Yankee*	*Whirlwind*	*Enterprise*	Challenger *Shamrock V*
Length water line	83 0	84-0	86–0	80-0	81 0
Length over-all	125-11	126–0	130-0	120-9	119–10
Extreme breadth	20–3	22–6	21–7	21–8	19–8
Draft	15–0	14–9	15–6	14–5	14–8
Displacement (tons)	143	145	158	128½	134
Sail Area (sq. ft.).	7568	7550	7550	7583	7540
Height of mast.	164	162	166	168	163

Principal dimensions of the Cup yachts

Crash-Testing Tires at High Speed

WHICH of these will best stand the force of tremendous impact: A 10-ton brick and concrete wall, reinforced with steel, and sunk deep in earth, a 3000-pound eight-cylinder automobile, or a few pounds of rubber and compressed air?

The answer to this question was given when Captain Dick Grace drove an eight-cylinder touring car under full power at 37 miles an hour into a solid wall over three feet thick. When the car crashed, the entire wall, 15 feet wide, was moved several inches from its base, the powerful car was wrecked and the front end was demolished, Captain Grace was hurled high in the air by the impact, falling beside the car, but the tires on the car were not damaged in any way despite the fact that they had received the full force of the impact.

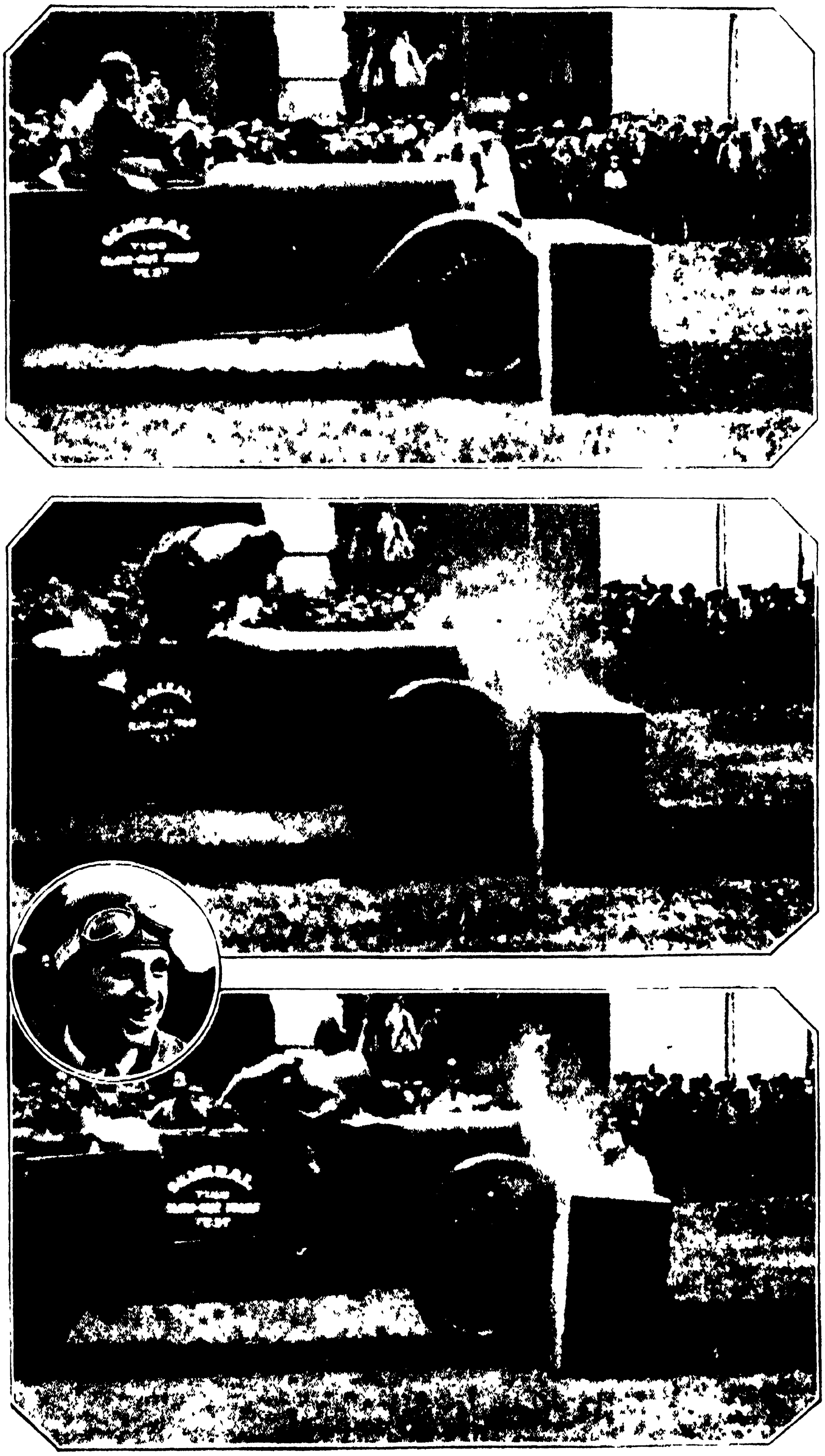
Because of the daring exploits of Captain Grace who intentionally cracked up airplane after airplane to furnish thrills in "Wings," "Lilac Time," and other spectacular air movies, the General Tire and Rubber Company asked him to give its new blow-out proof tires the most severe test he could devise. On the company athletic field, engineers built a brick and concrete wall, 15 feet wide, over three feet thick, and six feet in height, half of it buried underground. A heavy steel I-beam was built into it to reinforce it.

Captain Grace selected a powerful, eight-cylinder touring car with which to make the test. Before it was equipped with the new tires, the front wheels were moved forward so that they cleared the front springs and frame by six inches, making it certain that the tires would get the full impact of the crash. Then Captain Grace circled the field several times, gaining momentum for the final run.

The tires uninjured after the crash although the rim was badly bent

Just before the crash, he raised himself in his seat in a crouching position. With the throttle wide open, the car crashed into the wall, head-on. Slow-motion cameras revealed that the impact flattened the tires back against the rims, which were bent out of shape but the tires were uninjured.

"Such a test shows," said Captain Grace, "that tires will withstand the shock of driving over all kinds of roads at high speeds, even though they are driven unexpectedly into deep holes in the road."



Oomph! The car strikes the wall at 37 miles an hour. The upper left picture shows the flattened tires at the moment of impact; the center picture, the rebound; at bottom, the moved wall and the catapulting driver. In the inset, Captain Dick Grace

Our Patent System

By ORSON D. MUNN

Member New York Bar

THE Use and Abuse of Patent Rights: Just What Rights Our Patent Laws Grant to Patentees: The Government Cannot Give a Patentee the Right to Use the Invention of Any Prior, Existing Patent: Patents for Improvements Are Frequently More Valuable Than Pioneer Patents: Today, as Always, a Patentee Receives the Protection of the Government, in so Far as His Patent Rights Are Concerned, as Well as His Just Reward

THERE has been much unfavorable comment recently concerning our patent system. A western Senator has introduced a bill designed to prevent what is alleged to be the abuse of the rights secured by patents. The Government has instituted a suit against the so-called "Radio Trust," in which it charges that large and powerful corporations, holders of alleged "all-covering" patents, have by means of cross-licenses and agreements practically made it impossible for the independent manufacturer in the radio field to exist. We find others criticising our patent system because of the ineffectiveness of patents and the alleged lack of protection extended by the Government to inventors and patentees in general.

To determine whether or not the proposed legislation and the Government's action on the one hand, and the criticisms of the futility of patent protection on the other hand, are justified, we should first consider just what a patent is. It has been defined as a limited monopoly based on a contract between the patentee and the Government, wherein the Government, as an inducement to the patentee to make his invention known and useful to the people of the United States, promises to the patentee that for a limited period no one shall have the right to make, use, and sell his invention, without his consent. At the end of that period of time the patented invention becomes public property and may be employed by anyone. The rights secured by a patent are exclusive and the Constitutional provision under which inventions are protected provides only for the making of laws to secure "exclusive" rights to inventors. It is extremely doubtful whether Congress could pass any law, under this Constitutional provision, providing for the grant of anything less than an exclusive patent.

THERE are many who do not comprehend just what rights are given to a patentee by his patent. Many believe that a patent from the Government confers upon the patentee the absolute right to make, use, and sell his invention throughout the United States; but this is not the case. What he really gets is the right to exclude all others from making, using, and selling his invention. Obviously, this must be so, because many patents are granted for inventions which infringe prior patents; in other words, for improvements on the inventions of prior patents. Such improvements, everyone will agree, are patentable; but because they are patentable, the patentees get no right to use them if they embody the invention of a prior, existing patent. Our Government cannot take away from one citizen his property and permit its use by another such monopolies were never granted by our Government—so that when the patentee of an improvement gets a patent from the Government which, in terms, gives him the exclusive right to make, use, and sell his invention, he must remember that he does not get the right, and the Government cannot give him the right, to use the invention of any prior, existing patent.

Patents for so-called improvements are in many instances more valuable than a so-called "pioneer" patent. A case in point is the Bell telephone patent of 1877, which may rightly be designated as a "pioneer" patent. During its life many valuable patents were granted for improvement in the telephone art, and it may be conceded, without detracting from Bell's great achievement, that the practical commercial telephone was developed by these subsequent inventors; but not one of those patented devices could have been used by the owners without the consent of the owners of the Bell patent. Each of them secured to the patentee exactly the same rights that were given to Bell; that is, the right to exclude everyone from using the patented invention without the consent of the owner of the patent.

A patentee having this right of exclusion may do with his patent what he pleases, within the law. He may never put the invention in use during the term of the patent, and yet, he does not lose the right to exclude all others from using it. Having this exclusive right he may sell his patent to whom he chooses, or he may refuse to sell it. He may grant a license to anyone whom he chooses to license or he may refuse to license anyone; also, it follows that he may license those whom he feels like licensing and refuse licenses to others. In all of this no one has the right to complain; not even the Government which granted the patent.

BUT the Government charges that in some instances, as in the so-called "Radio Trust," these patent rights are used in such a way as practically to control the particular art and to eliminate competition, thus monopolizing the business of a particular industry. That this can be done is true, and no doubt patents can be and are used unjustly to intimidate competitors and to drive them out of business. Naturally, the Government cannot and does not complain that the owners of patents have granted licenses and cross-licenses to each other, because that is within their right.

Whether a corporation owns one patent or a hundred, or whether it be licensed under one patent or a hundred is immaterial, because each patent must stand or fall absolutely independently of all other patents, and the monopoly created by a patent is not expanded in the slightest degree by the fact that numerous patents are combined. It is true that a number of patents may afford a more extended protection to a given manufacture than would a single patent; but no one can complain of that. It is another thing, however, to say that an agreement between licensees and owners of patents that they will never license any others than themselves, is within their patent rights. That is the thing to which the Government objects; such agreements are not justified by the patent grant and are clearly in violation of our laws aimed to prevent monopolies and restraints of trade.

Again, patents may be and are used to intimidate independent manufacturers by unjustified charges of infringement and threats of litigation made not only to the manufacturer of the device alleged to infringe, but to the trade, and as the user or retailer is liable for infringement as well as the manufacturer, it follows in many cases that as an alternative to expensive litigation the manufacturer ceases the manufacture of the device alleged to infringe and the retailer not only refuses to buy them for resale, but oftentimes returns to the manufacturer those which he has already bought.

It would be entirely proper for Congress by some appropriate legislation to penalize those who make an improper use of patents in this manner, even to the extent of providing that they shall be deprived of all relief in a suit instituted by them charging infringement, should such a misuse of their patents be pleaded and proved against them. Indeed, without the proposed legislation, courts of equity have frequently denied all relief to the owner of a patent who has maliciously sought to destroy the business of his competitor, by circulating among the trade warning notices of infringement prior to an adjudication of the question of the suit. This, on the ground that the owner of such a patent comes into court with unclean hands and is not entitled to ask a court of equity for any relief.

The criticism, however, that patents do not protect inventors and patentees, and the suggestion that the Government should in some manner enforce the patents which it issues, is without any foundation whatsoever. It has been stated that no patent is of any validity until it has been through the courts, and that when one gets a patent all he gets is the right to a law suit. In just what manner the critics would have the Government proceed is not suggested.

IT is clear to anyone, however, that a valid patent is a protection to the patentee or owner of a patent, and that the Government does in fact protect him in his rights secured by a patent. The courts are always open to him, and it must be known to everyone that the courts constitute a branch of our Government.

The courts, it is true, will only extend their protecting arm to those patents which they find to be good and valid; but this is true of all contracts. No contract is self-executing. When you enter into a contract all you have is a promise in writing, which, if evaded and avoided and disregarded you must go to the courts for enforcement; and like a patent, such contract will only be enforced if the terms thereof are clearly stated and it is not invalid. A patent is no different in this respect from a deed for a piece of real estate; in fact much land in the west is held under patents issued by the Government. You cannot eject a trespasser from your property by simply waving before his eyes your deed and you cannot complain to a policeman to put him off of what you say is your property, because the policeman does not know whether it is your property or not. He may rightly differ with you as to whether or not he is a trespasser, or whether or not your patent is a valid patent. So that in all cases of contracts, patents, deeds, and agreements of any nature, you must seek the assistance of the courts to enforce them.

On the other hand, unadjudicated patents in many cases have proved of great value and been the source of much profit to the owners. In fact, there are instances where an inventor has sold his invention and the right to a patent even before the patent has been applied for or issued, and there are also many instances where an alleged infringer has recognized not only the validity of the patent but the fact that he has actually infringed the patent, and has ceased his infringing acts, or, by treaty with the owner of the patent, secured the right to continue the use of the patented invention. The owners of patents do not always have to go into court to obtain recognition of their patent rights and to receive the benefits to which they may be entitled.

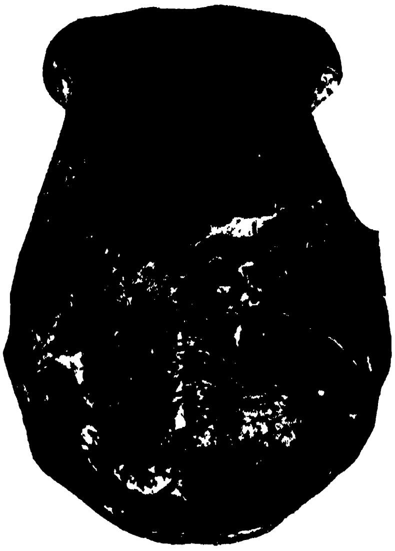
NO inventor, and no patent owner, should permit the present agitation, and the unjust criticisms of our patent system to deter them from creating new inventions and seeking patents therefor, nor should they be disappointed if the thing for which they have obtained a patent should not prove as valuable and useful as they anticipated. The Government is obliged to grant patents for new and useful inventions, but, obviously, there is no place in the arts for many of these patented inventions, either because they are impractical, or because there are things in existence for doing the same work, equally as efficient and economical, or because there is not sufficient capital available for commercial exploitation; under such circumstances no patentee should expect to profit by his invention. On the other hand, many cases can be cited where the inventors of simple things for which they have sought and procured patent protection have been amply rewarded and to an extent they never anticipated. It is true today, as it has been in the past, that the inventor or patentee of anything which materially benefits a given art or industry will not only receive the protection of the Government in so far as his patent rights are concerned, but also that reward, financial and otherwise, which the scope and value of his invention justifies.

More About the Peking Man[*]

By PROFESSOR G. ELLIOT SMITH, F.R.S.

Professor of Anatomy in the University of London
Author of "The Evolution of Man," and "Human History"

THE revelation of the nature of the brain-case in Early Pleistocene man displayed in the wonderful photographs reproduced in these pages affords ample corroboration of the claim made in *The Illustrated London News*[†] that the discoveries in China provide "a new basis for the study of human evolution." These photographs were made in Peking immediately after Professor Davidson Black had successfully accomplished his long and exacting task of clearing away the hard matrix of travertine in which the base and left side of the skull were embedded when it was found on December 2, 1929, by Mr. W. C. Pei.



The top of the skull of Peking Man, or *Sinanthropus pekinensis*

Now that the stony matrix has been removed from the surface—the cranial cavity is still occupied by a solid mass of travertine there is revealed the most complete example of an Early Pleistocene skull so far discovered. It is a very impressive and illuminating specimen, not merely for the intrinsic evidence it provides, but also for the light the new data shed upon the other remains of early man. It is the skull of a young adult or adolescent. Mr. Davidson Black suggests the possibility that it is female.

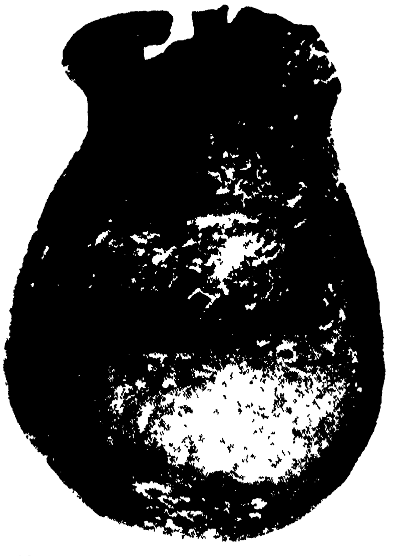
For the elucidation of its distinctive characters I have made two series of drawings in which the left profiles and the views from behind of the only three Early Pleistocene skulls so far known are shown superimposed upon one another. These drawings reveal the individuality of the new genus from China. While it has the prominent eyebrow-ridges of *Pithecanthropus* (which are lacking in the Piltdown skull), the brain-case is much fuller than the Java skull, especially in the frontal region, which approximates to the condition found in Piltdown man. But the latter is much better developed in the parietal and occipital regions than either of the Far Eastern skulls. The most striking contrast between the cranial forms of *Pithecanthropus* and *Sinanthropus* is revealed in the view from behind, in which the greater height and development of parietal eminences in the Chinese skull definitely differentiates it and justifies its generic distinction.

Sinanthropus Turns Out to be the Most Impressive and Significant Discovery in the Whole History of Human Paleontology

When Sir Arthur Smith-Woodward made his reconstruction of the Piltdown skull from the broken fragments found in 1912, he was vigorously criticised for making a model wider at the base (see the temporal bosses) than in the parietal region. The Peking skull reveals these peculiarities in a more extreme form. As it is an actual skull, and not a reconstruction, it provides welcome corroboration of the reliability of the reconstructed Piltdown skull. The outlines of the profile and posterior aspects of the Piltdown skull in the diagrams are taken from Figures 17 and 19 of my "Evolution of Man" (1927).

In his manuscript notes accompanying the photographs Professor Davidson Black claims that such a form (as is revealed in the posterior view of the Peking skull) is unknown in any other human skull. My drawings demonstrate the same peculiarity in the Piltdown skull. The collective testimony of these three fossils provides an impressive idea of the likenesses (as well as the generic differences) of these Lower Pleistocene men, and suggests the common denominator of the earliest man. The peculiarities already mentioned in the temporal part of the skulls (note, in particular, the temporal bosses in all three) do not exhaust its interest. The form of the mastoid processes (which seem not to have been fully extruded—as they are in other men—from the cranial wall) and the massive ring of rough bone (tympanic) surrounding the ear-hole, differ profoundly from the corresponding parts of all other human skulls. The peculiar modeling of the tympanic bone displays a startling resemblance to the condition found in the gorilla and chimpanzee. The mastoid and tympanic structures have distinctive characters in Piltdown Man, Rhodesian Man, and Neandertal Man, but none of these is so emphatically simian in type as the Peking skull.

WITH the photographs of the skull there has also come Volume VIII of the "Bulletin of the Geological Society of China," containing three important memoirs which throw a clearer light upon the history of the discovery of *Sinanthropus* and the geological and paleontological evidence for the antiquity of the human fossils and the animals associated with them. The Chinese geologist, Mr. W. C. Pei, gives an account of his discovery of what is probably the most important, and certainly the most illuminating, fragment of early man ever found. Father Teilhard de Chardin and Dr. C. C. Young have provided a preliminary report on the fossiliferous deposits at Chou Kou Tien, which not only establishes the fact that all the



The skull of *Pithecanthropus*, for comparison with that of *Sinanthropus*. (See also opposite page)

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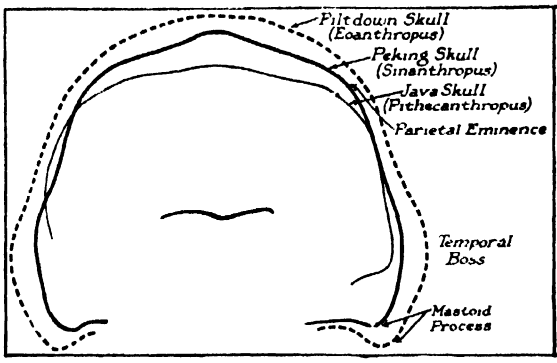
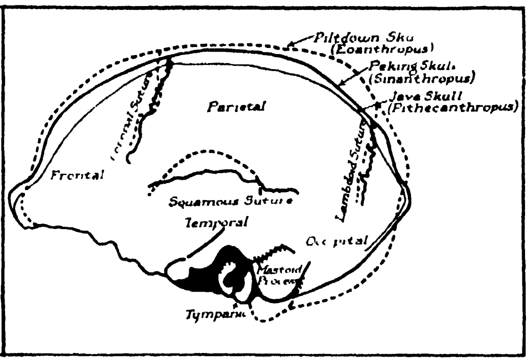
[*] Reproduced by permission of *The Illustrated London News*

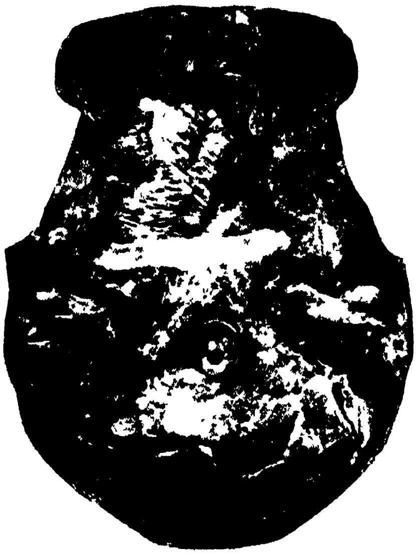
[†] The article in question, written by Professor Smith, was reprinted in SCIENTIFIC AMERICAN, June 1930, page 440



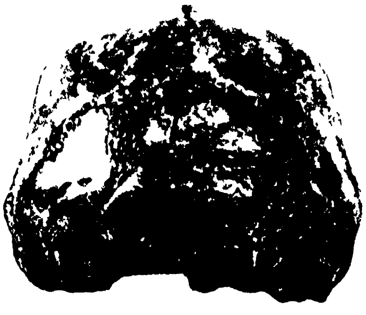
With posterior aspects superimposed, three famous skulls—Piltdown (*Eoanthropus*), Peking (*Sinanthropus*), Java (*Pithecanthropus*)



Left profiles superimposed. The same three skulls whose posterior profiles are superimposed at the left. Drawings by the author

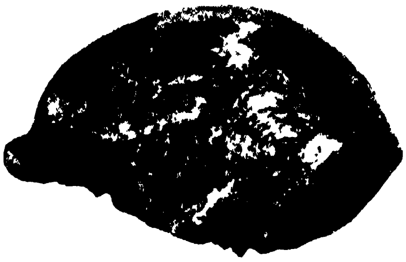


Base of the skull of *Sinanthropus* (the round central object is recent)

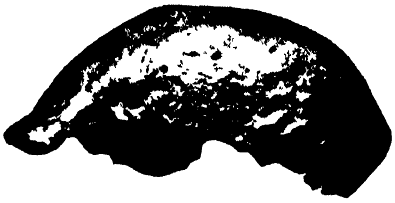


Sinanthropus, rear. The parietal eminences mentioned in the text are indicated in the drawing above

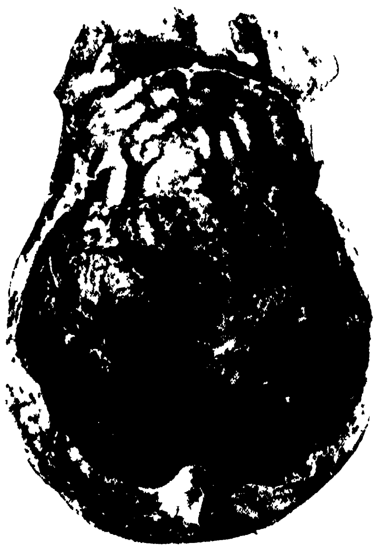
Pithecanthropus, rear. For position of "temporal boss" see the drawing



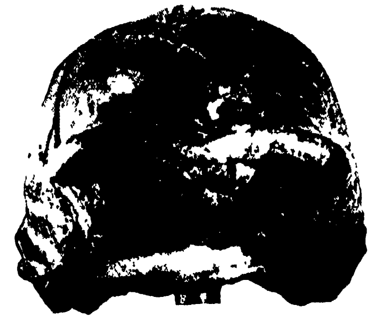
Sinanthropus, profile. It has a fuller brain case than *Pithecanthropus* (which is shown at right)



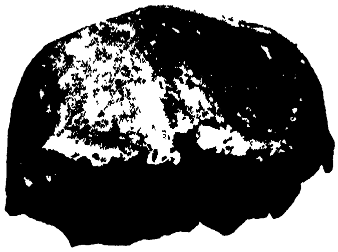
Pithecanthropus, profile. *Sinanthropus* (at left) has the same or more prominent eyebrow ridges



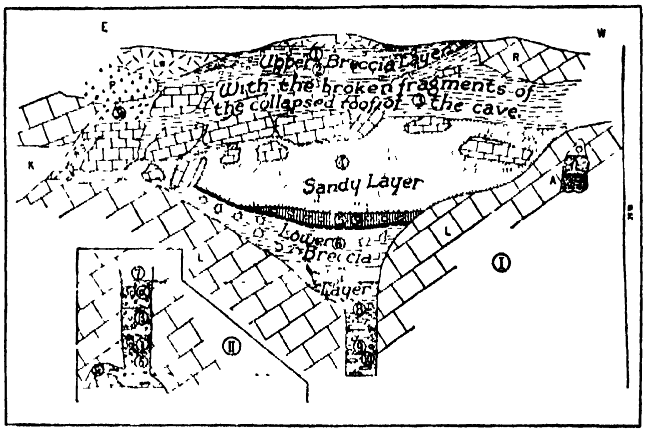
Base of the skull of *Pithecanthropus*—smaller than *Sinanthropus*



Sinanthropus, front. Happily the eyebrow ridges are not even partially lost, as in *Pithecanthropus*



Pithecanthropus, front. *Sinanthropus* has the same frontal expansion as has *Pithecanthropus* remains are later than the Pliocene and earlier than the Loess—in other words, they are Lower Pleistocene—but also hints at the possibility that in the lower layers of the formation (the highly fossiliferous beds of Nihowon) they may find "some immediate ancestor of *Sinanthropus*." Professor Davidson Black has described (with many excellent photographs) the process of liberating the skull from its matrix.



Where "the most illuminating fragment of early man ever found" was discovered at point marked "SE" (extreme lower left-hand corner). The jaw and skull fragments found a year earlier were at "SB," (top, left)

The evidence provided in these three memoirs makes it possible for us in Europe for the first time to visualise the circumstances of this epoch-making discovery. These facts are essential for the understanding of the significance of the new light on our remote ancestry. For several decades European paleontologists have been exploiting the druggists' shops of China for fossils — "dragon's bones" being an important item in the pharmacopœia of the Far East. But it was not until 1919 that a subsidiary bone deposit near Chou Kou Tien was visited by Dr. J. G. Anderson on behalf of the Geological Survey of China. Two years later (1921) he discovered the important main deposit and began excavating it. But its exceptional scientific importance was not realised, even when in 1926, Dr. O. Zdansky found two human teeth among the fossils that had been collected. The Rockefeller Foundation then gave a grant of money to help the Geological Survey of China and the Department of Anatomy of the Peking Union Medical College conjointly to carry on excavation for two years.

IN October 1927, Dr. Birger Bohlin found *in situ* in the Early Pleistocene beds a human tooth, on the evidence of which Professor Davidson Black and Dr. O. Zdansky created the new genus and species *Sinanthropus pekinensis*.

Dr. Zdansky was still sceptical of the justification for the creation of a new genus and species, and the credit of insisting upon the necessity for such action must be attributed to the insight and courage of Dr. Davidson Black, who naturally associated Dr. Zdansky's name with the discovery in view of the circumstances under which the two teeth were rescued in 1922 and described by him in 1926.

A year later (November 1928), Mr. W. C. Pei, working with Drs. Birger Bohlin and C. C. Young, found much additional material, including parts of two lower jaws and numerous skull-fragments of *Sinanthropus*. This induced the Rockefeller Foundation to make an additional grant for the work, and a special department (Cenozoic Research Laboratory) was set up by the Geological Survey of China and put under the honorary directorship of Professor Davidson Black.

The hope implied in the granting of this new appropriation was immediately realised by the most impressive and significant discovery in the whole history of human paleontology. Mr. Pei resumed work in May 1929, and in June and July found a number of human teeth. The summer rains then stopped work for seven weeks, so that it was not until September 26 that excavation could be resumed. Another collection of *Sinanthropus* teeth was then found.

At the end of November, when the weather was becoming bitterly cold, Mr. Pei was so "curious to know what were the lower layers of the deposit" that he prolonged the work for two more days. He found two caves, in one of which, at 4 o'clock on December 2, he found, "partly embedded in loose sand and partly in a hard matrix," the almost complete skull of *Sinanthropus*. He sent special messengers to inform Drs. W. H. Wong and C. C. Young, and telegraphed to Dr. Davidson Black.

THE circumstances under which the remains of *Sinanthropus* were found are totally different from those of *Pithecanthropus* and *Eoanthropus*. The latter were both scattered and deposited in gravels by running water. The Peking Man lived in caves, and left his remains there. According to Father Teilhard de Chardin and Dr. Young, it is probable that not only the rodents, hyenas, bears, and other carnivora roamed the site, but also *Sinanthropus* himself may once have sheltered within the Chou Kou Tien cave. Vast quantities of fossil bones have been found. The most interesting types, apart from *Sinanthropus*, are the big beaver (*Trogontherium*), the primitive water-buffalo (*Bubalus*), and the strange deer (*Euryceros*), whose extremely thickened jaws and facial bones and short, flattened antlers are perhaps the most characteristic of the fossils found at Chou Kou Tien. *Machairodus* is exceedingly rare.

The fossils are scattered in the layers filling the cave from top to bottom, and all belong to the same geological age. While a few of the bones may have been introduced into the deposit by a brief flood action (*Bubalus*, for example), most of the material was clearly left (or brought in) by animals living in the cave. The fossiliferous material was set by a slow process of weathering under humid conditions (water infiltrations and occasional brief flooding), but without any torrential action. Although a stream flowed near the cave, there are no true river-deposits. The characters of the breccia and of the fossilised bones indicate that the site was not an underground, water-drained fissure, but an ancient, gradually filled, open-air cave.

SUCH was the home of *Sinanthropus*. The conditions arouse more reasonable hopes than can be entertained in the cases of *Eoanthropus* and *Pithecanthropus*, not only of finding other parts of the skeleton, but also the objects used by Peking Man. It is surprising that no implements have yet been found in the cave. Mr. Pei recovered an angular piece of quartz—a type of stone not found naturally—within a mile of the cave. Similar quartz-fragments have been found from time to time during the course of the excavations, but in none of them has any recognizable trace of artificial breaking been found. It is inconceivable that any creature which had attained human rank could have failed to make some sort of tools of stone. Yet Peking Man occupied this cave for a long time, and does not seem to have left with his bones anything beyond some unworked quartz!

Alongside the skull of *Sinanthropus* was found the complete skull of a rhinoceros, with its lower jaw in position. Mr. Pei ends his reports with this passage, which excites the liveliest anticipations of what next summer may bring forth: "The layer below the one just described is exceedingly rich in fossils, which are so crowded together that but little matrix separates individual bones. Not only are the fossils rich in quantity, but their quality is extraordinarily good."

Arcs of Art

The Camera Analyzes the Electric Arc

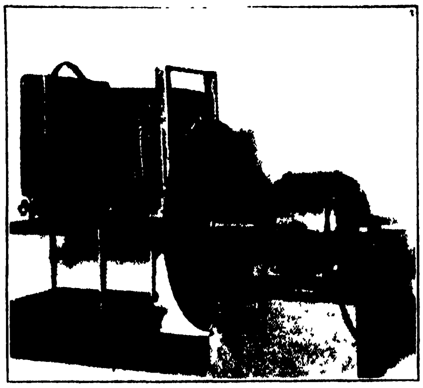
By HENDLEY N. BLACKMON

General Engineer, Westinghouse Electric and Manufacturing Company

SOME electric arcs form a most exquisite tracery—a weird gossamer picture of bright and dark bands of light emerging from a misty halo. These striated arcs are made by bringing one end of a 150,000-volt wire close enough to the other terminal for an arc to jump across. Once started, the arc hangs on until it is "stretched to death" when the terminals are pulled far apart.

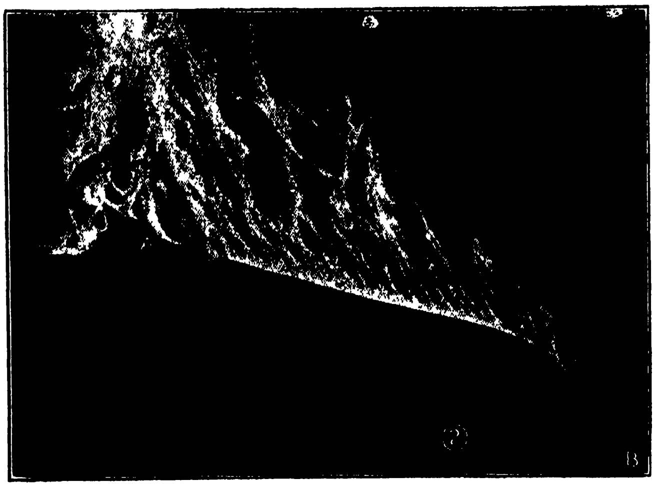
In order to find out what happens at various points on the changing voltage wave, an electrically timed camera was used. This camera has a synchronous shutter consisting of a motor-driven disk with four radial slots, rotation of which times the camera to take pictures of the arc at any desired portion of the voltage wave. The pictures it makes show the physical characteristics of unleashed electricity and have helped scientists in solving the problem of the behavior of electric arcs.

In the accompanying illustrations, Figure 1 shows how the halos are masked out by the synchronous shutter. Figure 2 shows what happens in the life of the arc: the arc began at "A" when the electrodes were 1½ feet apart, and was stretched 8 feet so that it finally went out at "B." The arc trailed off like a comet because at the left the electrodes were close together and more power was produced. As the arc was drawn out, the heated air carried the flame upward, the flame decreasing as the air gap was widened.



The arc-photographing camera with its motor-driven disk shutter

Figure 3 shows the sort of picture obtained by not opening the camera shutter until the arc has been drawn out quite a distance. Figure 4 was taken under the same physical conditions as Figure 1, but the halo is not masked out entirely; note the halo at the bottom and the sharply defined layers at the top of the arc. Figure 5 is a snaky specimen of the striated arc.



The Pattern of Evolution

A Criticism of Doctor Austin Clark's Thesis†

By W. D. MATTHEW, Ph. D.

Professor of Paleontology, Chairman of the Department of Paleontology, and Director of the Museum at the University of California

A GREAT many people are talking about evolution nowadays. Most of them do not know much about it and, generally speaking, the less they know about it the more it horrifies them. The theory of evolution, when you come to know it well, is not only of marvelous and inexhaustible beauty, but is an inspiration to a higher type of idealistic living than any orthodox religion.

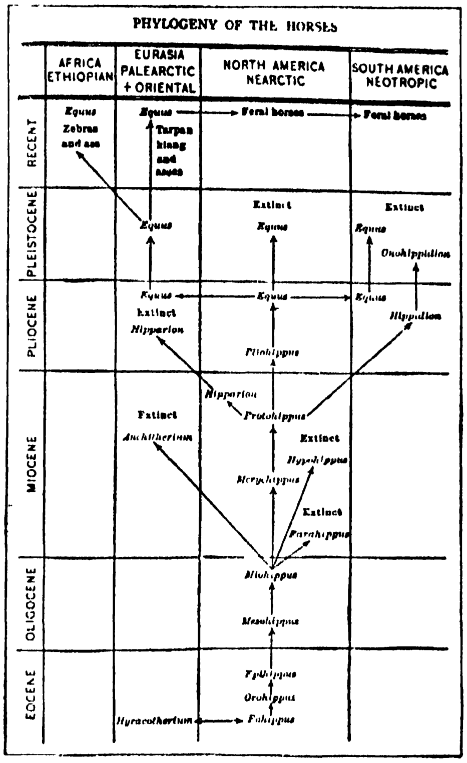
Doctor Clark, as a distinguished biologist and a specialist in certain groups of modern invertebrate animals, is very distinctly one who does know what he is talking about, and his views and conclusions about evolution are entitled to very careful and respectful consideration. If in the following pages I find it necessary to criticize and modify his statements of evidential fact, it should be understood that it is because they lie for the most part in a field that is my specialty but not his, the field of paleontology, and especially of vertebrate paleontology. In a scientific discussion the facts and the immediate interpretations that may legitimately be placed upon them are usually matters that must rest largely upon the authority of specialists. The soundness and validity of the conclusions drawn from these facts are matters of logic on which any reasonable man can and should judge for himself.

IN attempting to explain the principle of evolution (for it is a principle, not a theory, to the paleontologist) as it has actually worked out in the past history of life, certain aspects and effective illustrations have necessarily been selected from the record. These have been popularized and stated in some detail, while other parts of the evidence, often equally convincing but less readily explainable or of less general interest, have been omitted or briefly and casually summarized. This other evidence is quite necessary to any complete understanding of the nature of the record, but much of it is very difficult to get at, published only in technical papers scattered through numerous scientific journals. Much of it has never been printed at all; the specimens and records are stored out of view of the public in the research rooms of various museums, their existence known to the merest handful of specialists.

Such evidence, not yet assembled nor made available to the general student, yet serves to color the thought of specialists and control their interpretation of the better known data. Its existence, and, I may add, its controlling importance in the interpretation of our problems, is the reason why, in the free democracy of science, we may grant "authority" to individuals in their special line of research.

I do not agree with Doctor Clark's conclusions in this essay, because I think he has not fully understood the paleontological evidence, nor the geological and geographical background against which it must be viewed for correct interpretation. But he has quite properly pointed out certain neglected aspects of the evidence which make it less convincing as commonly presented than it really is when fully known.

These lie in two fields. First, that of the fossil record of the evolution of the various races of mammals in the Tertiary period—my own particular subject—and of the different orders of reptiles and classes of vertebrates in preceding periods. Second, the broader problem of the relationship and origin of the great phyla or branches of animal life, of which the vertebrates are one.



In the evolution of the horse there were several branch lines, none of which has survived, as shown in the cut

As concerns the first, I am obliged to take exception to his presentation of the evidence, as incomplete and in this connection misleading, and to his interpretation of it as failing to take into account the geologic and geographic background which controls its significance. He gives a brief and fairly correct summary of the record of the evolution of the horse, tracing it from the little four-toed *Eohippus*. But he does not mention that such diverse animals as the rhinoceros and the tapir are likewise traceable to small four-toed ancestors contemporary with the Eocene four-toed horses, and so like them that the most expert specialists have not always been able to distinguish the one group from the others.

Moreover, he speaks of the equid series as though it were a single line, and has elsewhere spoken of it as "an example of linear evolution." But it is not; there were several branch lines more or less clearly defined, running into parallel or partly diverse adaptations, none of which has survived to the present day. And in each stage of the main line of evolution of the modern horses there were several species, some more, some less in the direct line of descent. The record has, in fact, the familiar form of the phylogenetic tree, continually dividing up into branches and twigs of more or less importance, and the series customarily presented is merely the direct line leading up to the modern horse. From the same common ancestral stock are derived other lines of specialization, each one similarly branched, and two of them surviving today in the rhinoceroses and tapirs.

MOREOVER, the actual record of fossil perissodactyls [hoofed animals with odd number of toes.—Ed.] as known to us to-day is obviously a very incomplete one if we view it in the light of geology and geography. The living members of the horse family consist of a number of related species—wild horses in Asia, wild asses in Asia and north Africa, zebras in Africa—scattered over considerable parts of the earth's surface, different species in different regions. The rhinoceroses are similarly distributed in southern Asia and Africa the tapirs in Malaysia, and Central and South America. Each family had a much wider distribution at the end of the Tertiary period, and during the Tertiary they were widespread, numerous, and varied through all the northern continents, the living members of the group being a few widely scattered, specialized survivors of a disappearing group, all probably on their way to extinction.

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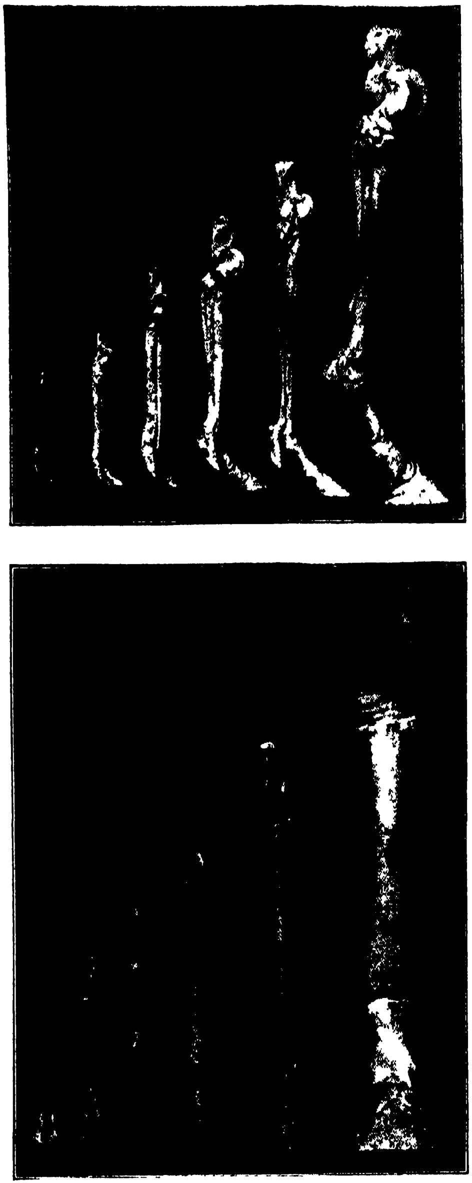
†Scientific American, August, 1930, Page 104

At each successive stage in their evolution, at each epoch of the Tertiary, there must have been numerous different species of "horses," as also of rhinoceroses and tapirs, living in various parts of the northern continents (Europe, Asia, and North America), some ranging over considerable parts of the continent, some confined to restricted areas, slowly shifting their range, becoming more abundant and widespread or less so, as similar animals do to-day.

OUR fossil record, though derived from many places, represents only the animals from small localities, scattered here and there over the continental regions, most of it from a few areas in the middle-western United States and certain parts of western Europe. Out of the dozens or hundreds of species of the family that were living in different parts of "Holarctica" (the aforesaid northern continents) at any one epoch or stage in the evolutionary history, we actually know only a few, and of these one appears to be more directly intermediate than others between the earlier and later stages. It is the closest known approximation to the direct line of evolution.

Our record, then, while it gives a correct picture in a broad way of the evolution of the race as a whole, reduces to a series of approximations more or less close to the detailed and exact phylogeny of any one line of descent. This is the explanation of the "gaps" of which Doctor Clark speaks, and which he thinks, as many other biologists have thought, must be due to some sudden great or considerable change in structure of the same nature as the "sports" with which Darwin and all breeders of plant or animal races were familiar in the last century, and which, under the name of mutations, have been so thoroughly and profitably studied by the geneticists of this century.

But it is not probable, in view of the nature of our fossil record, as outlined above, that the gaps in our evolutionary sequences are many, if any, of this nature. For they are very directly proportioned in numbers and in width to the scantiness and inadequacy of our record. Where the records are most abundant, and especially where we have reason on various grounds to believe that they come from points in or near the center of evolution and dispersal of the race, the habitat of the most progressive species, there these gaps almost or entirely disappear. In general it may be said that the more complete our record of any race the nearer it comes to being continuous, or separated by gaps which, although definite, are not beyond the limits of ordinary individual variation in a species.



Courtesy American Museum of Natural History

Side and front views of the evolution of hind feet of the horse. The smallest is *Eohippus*, then come *Mesohippus*, *Miohippus*, *Merychippus*, *Hipperion*, and *Equus*, the modern horse

The nature of these variations is much better understood than it was in Darwin's time, thanks especially to the researches of T. H. Morgan and his school. Some of them are inherited according to certain definite laws. They are "mutations" of the same nature as the larger, more conspicuous and more occasional mutations which the geneticists have studied in detail. Others are the non-heritable differences between individuals, due to slight or considerable differences in their environment and growth history.

Now it is to be observed that almost any major or conspicuous departure from the normal in an individual would have little or no chance of giving rise to a permanent change in the race. In almost all cases it would be immediately fatal or seriously detrimental to its chances for survival. For each animal is closely adjusted in habits and environment to a particular adaptation, a particular mode of life. With any important single change in its structure it would cease to be an efficient working mechanism. With any conspicuous change in appearance it would become a stranger to its fellows and as unpopular with them as strangers usually are. And even if it succeeded in leaving a few descendants, the chances that these would possess any superiority to their numerous normal competitors would be infinitesimal. Practically all cases in all combinations with the normal would result in an inferior mechanism, sooner or later to be eliminated by natural selection.

WITH the minute heritable differences these disadvantages would not exist. We are familiar with them in our own species and with all animal and plant races.[1] And moreover, the various correlated small differences in other parts of the organism necessary to make an efficient working mechanism can be and are adjusted by individual growth. This is a temporary adjustment, repeated generation after generation until it can be replaced by the appearance of the necessary inherited variations, thenceforward a permanent though small step forward in the evolution of the race.

We must think of each species as it is in nature, each race as it always has been in nature, as a complex of interbreeding strains, each having certain slight differences in inherited characters, intercrossing over and over again until some profitable combination of variations occurs, to be preserved, increased, and finally made universal by natural selection, and disadvantageous characters and combinations eliminated in the same manner. It is a process of almost inconceivable slowness. To change one species of horse into another seems to have required something like half a million or a million years - two or three hundred thousand generations. No appreciable change would occur in a few thousand years; but in the larger view of the geologic time scale it is seen to be cumulative, resulting in a slow progressive change in adaptation to equally slow changes in climate and environment.

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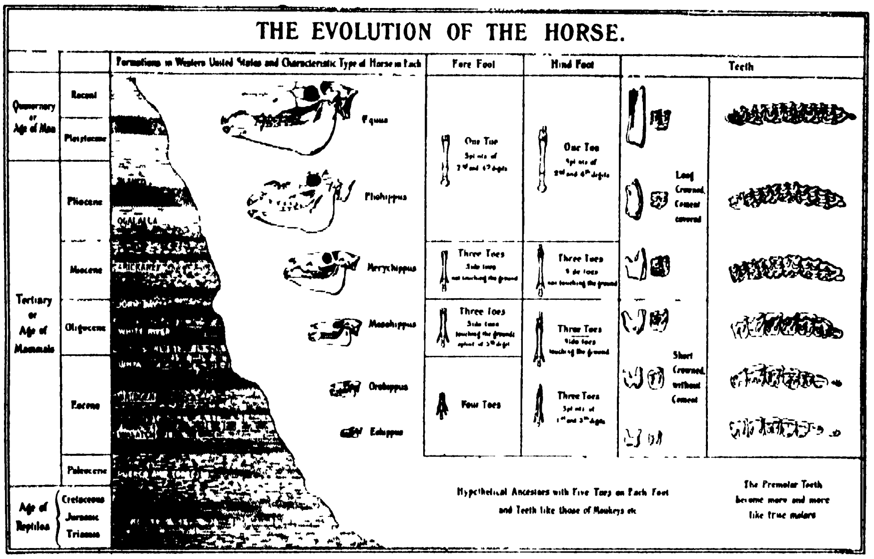
[1] Men slightly taller than the normal are common, and are apt to excel in many lines of athletics. Seven- or eight-foot giants are rare, and are always more or less crippled and handicapped by their abnormal height, its lack of adjustment to other proportions and to the world they live in. They seldom live to old age and find employment difficult except in the circus. So with any wide and conspicuous variation from the normal. It is of relatively rare occurrence, and *it is a handicap, not an aid to survival.*

Large changes, conspicuous mutations, can play little or no part in this slow process. A three-toed sport from a four-toed horse would be a cripple. He would not have the numerous correlated adaptations necessary to make of him a good working mechanism, all of which are present in the three-toed horses. No sport that I have ever seen or heard of is at all analogous to such a great series of differences as those that separate the four-toed from the three-toed horses. Very few of the sports and conspicuous mutations would have any chance of survival in competition with the normal members of their race. Still fewer would be those that would be at all likely to give rise to new races. Yet there are a few isolated and exceptional instances among modern animals where certain peculiarities can best be explained as due to such heritable variations of considerable amount. It is the rare exception, and there is no reason to suppose that it played any part in the recorded evolution of the horse.

THE entire history of the perissodactyl order resolves itself then into a branching out from a common ancestry very nearly represented by the *Eohippus* into such diverse specialized types as the horse, the tapir, and the rhinoceros, with various other specialized races that have not survived, and each branch in turn has its minor branches and twigs of which in the horse only one has survived and has itself begun to branch out into horses, asses, zebras, and so on. The record is fragmentary, but no other reasonable interpretation can be placed upon it than to see it as a slow, gradual change quite analogous to the growth and branching of a tree, and like it conditioned in direction, amount, and character of growth, by the circumstances and advantages of the environment, and by the continuity of life. And this is the general pattern of evolution, which we see illustrated in every race of animals and plants whenever our record is adequate to show its real character. The more complete the record, the more precisely it conforms to the pattern.

After a "bone-digger" has studied and compared all the known material, fossil and recent, old and new, in a group of animals, and found them all to fit into this pattern; after he has gone into the field and secured new fossils from new formations and previously unknown stages, and found them also fitting into the pattern and filling some of its gaps; when he has repeated the operation on group after group, and learned from reading and conversation that it is identical with the pattern determined by his confrères in various other fields of paleontological research; that it has stood the test of a century of criticism as to its theoretical as well as practical soundness—he gets to feel that the phylogenetic tree as the true pattern of the history and evolution of life is a pretty fundamental and certain matter, that it has taken this form because, short of miracles, it could take no other. In so far as the record goes it definitely does take this form. Where the record is absent, we should assume the same pattern unless there is convincing evidence for a different interpretation of existing life.


THE EVOLUTION OF THE HORSE.
Formations in Western United States and Characteristic Type of Horse in Each
Fore Foot
Hind Foot
Teeth
Quaternary or Age of Man
Recent
Pleistocene
Tertiary or Age of Mammals
Pliocene
Miocene
Oligocene
Eocene
Paleocene
Age of Reptiles
Cretaceous
Jurassic
Triassic
Equus
Pliohippus
Merychippus
Mesohippus
Orohippus
Eohippus
One Toe Splints of 2nd and 4th digits
One Toe Splints of 2nd and 4th digits
Three Toes Side toes not touching the ground
Three Toes Side toes not touching the ground
Three Toes Side toes touching the ground; splint of 5th digit
Three Toes Side toes touching the ground
Four Toes
Three Toes Splints of 1st and 5th digits
Long Crowned, Cement covered
Short Crowned, without Cement
Hypothetical Ancestors with Five Toes on Each Foot and Teeth like those of Monkeys etc
The Premolar Teeth become more and more like true molars

Doctor Clark states, however, that this is not the case with other groups whose fossil record is at least partially known, and instances the cats and dogs as an example. Cats were cats and dogs were dogs, he tells us, and as far back as their history can be traced there is no approach between them. I do not know where he got this information, but it is quite incorrect.

Let us look for a moment at the facts. Cats are among the most highly specialized of the Carnivora in the reduction and special adaptation of the teeth, but are very generalized and much like the older extinct and more primitive living Carnivora in the limbs and feet. Dogs, on the other hand, have retained a comparatively primitive dentition, but have specialized considerably in the limbs and feet for swift running. Both have a high type of brain among the Carnivora, and a variety of minor special characters are found in one or both.

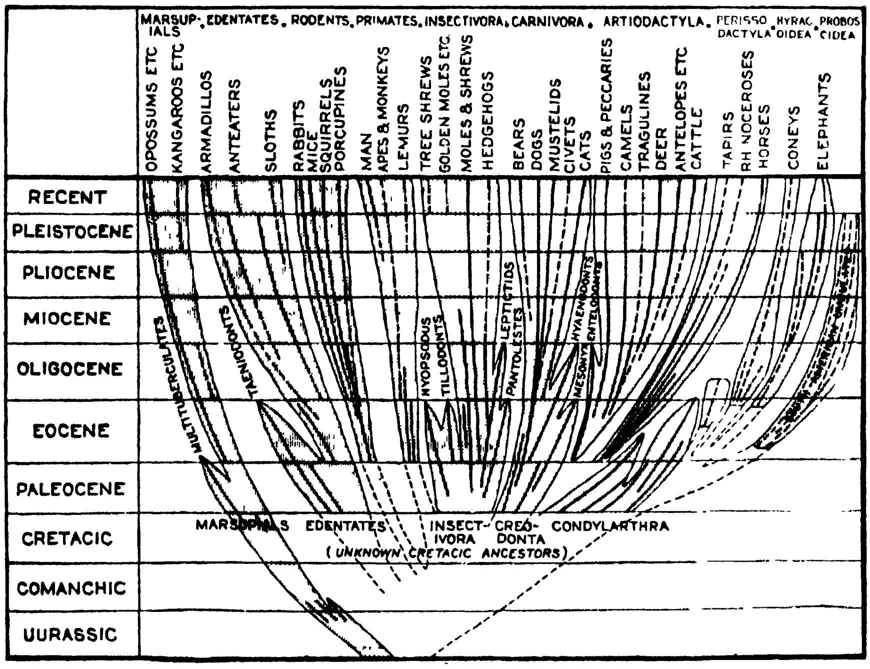
Now we can trace back the cats and dogs through a fairly complete series of stages to the Oligocene epoch of the Tertiary, and the dog ancestry is a pretty close series beyond that to the beginning of the Eocene, but little is known of the earlier ancestry of the cats. The Oligocene dogs are but little different in the teeth from their modern descendants, but the limbs have much more nearly the cat proportions, the feet have five toes, like cats, and the claws are partially retractile. The Oligocene cats on the other hand are much like modern cats in limbs and feet, but have more numerous and less specialized teeth.

When first found, these Oligocene ancestors were not recognized as cats and dogs, as the names of the earliest discoveries testify. *Cynodictis* (i.e., dog-toothed weasel), *Daphænus* (devourer, i.e., glutton or wolverene) are now recognized as ancestors of the dogs, *Aelurogale* (i.e., cat-marten) and *Dinictis* (i.e., terrible weasel) as ancestors of the cats, but these relationships were not at all clear to the experts who first described them. Not until the intermediate series were discovered could the real affinities be demonstrated.

IT appears, therefore, that Doctor Clark is wholly mistaken in supposing that cats and dogs make no approach as we trace their ancestry back. They are already distinct in the Oligocene, but most of the wide differences that separate them today have not yet appeared. Could we trace the cats back through the Eocene, we should presumably find them gradually merging into a common ancestry with the dogs, which we can so trace, and whose Eocene ancestry is merged in exactly this fashion with that of mustelids (otters, minks, skunks, and so on) and bears and raccoons and civets. It is identically the same pattern as we have seen in the horses, tapirs and rhinoceroses, and goes step by step along with it in time. (See cut.)

I fully agree with Doctor Clark - and with Darwin - that the selection and differentiation of the various domesticated breeds of animals affords the most important illustration of how natural selection has operated. But I can not at all agree with his statement that there are no intermediates between the principal breeds of dogs as he cites them, nor with his implication that they all appeared suddenly in their modern stage of specialization. Any dog-fancier or student of the history of the breeds of dogs could set him right on that better than I can, but I am sure from what I have read that the different breeds, while originating in part as sports, have been largely developed and modified through centuries of selection and inter-crossing. The whole subject of variation under domestication has been very thoroughly treated by Darwin and others, and its relationship to natural selection is largely affected by the fact that most of the breeds as at present developed, while useful to man for certain purposes, would have but little chance for survival in nature. Some of them are probably based upon wild species, and would doubtless revert to type in time if they ran wild; but there is no reason to suppose that these wild species were evolved in any but the normal manner.

Concerning the evolution of man, Doctor Clark does not say much, but again I must take exception to some of his statements. He emphasizes the distinctness between man and the great apes "in every bone of the skeleton," and assures us that "the differences seem too great to have ever been bridged by intermediate types," and that "of all the fossils that have been found not a single one represents indubitably a missing link."



Redrawn from Matthew, in "Problems of American Geology," Yale University Press

How the mammals deployed during the Tertiary period. Despite the indicated gaps a careful study of the subject will point to a common ancestor of all the mammals. Note under "Carnivora" (at the top of the cut, just to the right of the center) the dog-cat ancestry mentioned by the author

I do not know how far he is acquainted with the demonstration made by Huxley and confirmed by many subsequent writers, that the anatomical gap between man and the anthropoids is less than between these and the monkeys, less than between monkeys and lemurs, and that the differences are very largely superficial adaptations. But if by a missing link he means any intermediate stage or stages, I can not see how he would explain away the characters of the Neandertal man, which differs from modern man in a dozen or more obvious distinctive characters of teeth, skull, jaws, and skeleton, every one of them except his "taurodonty" constituting a definite approach to the anthropoid apes. Or the characters of the recently discovered Peking man and of the Piltdown man, both early Pleistocene, older than the Neandertal man, and making a further approach in most, although not all, characters to the anthropoids—the Peking man having more human teeth but a very ape-like jaw, the Piltdown man so apelike both in teeth and jaw that some authorities have insisted that the jaw could not have belonged with the skull, which is still dominantly human. Or of the Taungs skull from South Africa, related to the chimpanzee, but making an unmistakably nearer approach towards the human type. Or the classic *Pithecanthropus* of Java, which has a skull-cap and brain construction about half-way between ape and man.

If these are not intermediate stages, what are they? If Doctor Clark means that they are not "missing links" because they are no longer missing, I quite agree, and only wish that more could be discovered, and that all of them were as fully known as the Neandertal man is today, thanks to Marcellin Boule.

Again Doctor Clark makes a great deal of family life and the dependence of women, of articulate speech and the use of tools and fire, as fundamental distinctions between man and all other animals. But there is a pretty wide difference between man and man in these and most other distinctions, physical or mental. It is not especially rare among primitive races of man, or civilized races under primitive conditions, for a woman to bear and rear offspring without the help of man; nor do I think it is wholly the custom among apes, as it certainly is not among various other animals. The great apes are not "promiscuous," nor indeed the monkeys, although they are not monogamous; and various degrees between polygamy and promiscuity are not particularly uncommon among the lower races of man. Is the difference between an animal that has a dozen or more sounds expressive of definite concepts or feelings and a savage who has at most a couple of hundred, so very much greater than between the latter and a man of science with a vocabulary that runs into the tens of thousands?

THESE are all matters of degree, as are all the distinctions seen by science between man and animals. If indeed Doctor Clark had declared for the presence of a soul, as do the orthodox, as the fundamental and impassable gulf between man and animals, I would have nothing to say. As a man of science I know nothing one way or the other about souls, and my religious convictions I do not think it necessary to express in the SCIENTIFIC AMERICAN. But so far as scientific evidence and the fossil record are concerned, it appears to me that it fits very clearly and convincingly into our pattern of evolution, and that the descent of man and the anthropoid apes from a common ancestry is far better proved than many things that we implicitly believe. There is, I am well aware, a divergence of opinion among eminent scientists as to how far back that common ancestry should be placed and just what relationship should be assigned to the apes.

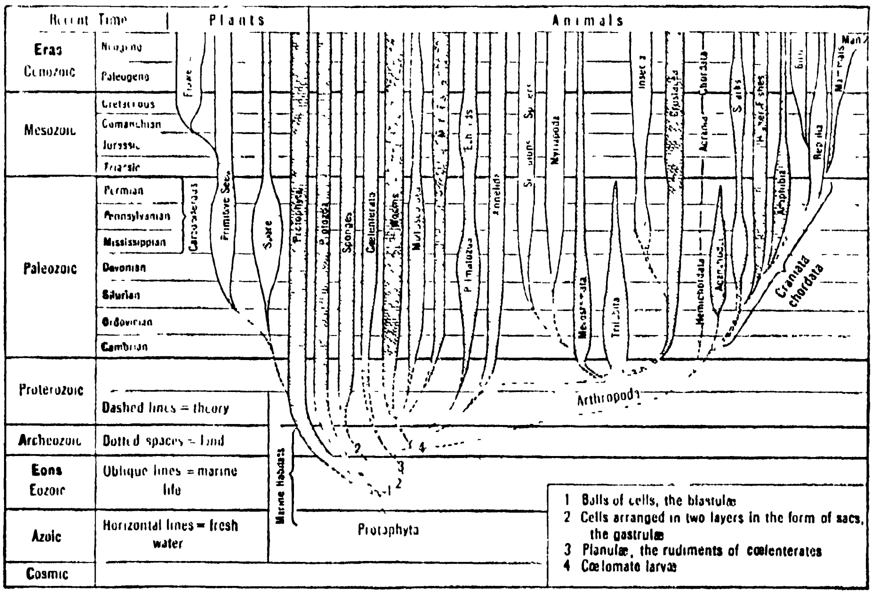
Turning now to what Doctor Clark has called *eogenesis*, that is, the origin of the great branches or phyla of animal life. as he fully recognizes, the origin of these great branches must be carried back toward or beyond the beginnings of the geologic record, while our fossil record extends back only through the later half of that record. The rest is inference. If it were true, as he gives us to understand that it is, that each great branch appears in the Cambrian period as clearly distinct, as fully differentiated and specialized as it is today, then it would be a reasonable inference, although far from being necessarily or even probably true, that that degree of distinctness continued on back indefinitely. The alternate view would be that, having in the course of evolution attained the full degree of specialization that was of any net advantage to the organism, natural selection would cease to impel it any further and it would remain unchanged in the essentials of its machinery so long as it remained in the environment to which it was now completely adapted. If the environment changed, further changes might come about, not necessarily in the direction of progress. Otherwise it might well remain substantially unaltered from the Cambrian or a much earlier period, down to the present day.

I believe that that is pretty largely true of the lower groups of invertebrates, the groups with which Doctor Clark is especially familiar. Cambrian protozoa, Cambrian sponges and jellyfish, are much like their modern relatives, probably just about as much specialized *so far as the hard parts show*. The same is at least partly true of the echinoderms (star fishes, sea urchins, and so on). Whether it is true of worms nobody really knows. But when we get into the higher groups, the molluscs and arthropods (spiders, crabs, insects, and so on), and especially the vertebrates, it is very far from true. The Paleozoic era molluscs or arthropods do not have nearly the degree of diversity and specialization that can be found among the higher modern molluscs. The earliest insects have not taken on the important specializations that characterize the higher groups of the class; they compare only to the lower and more primitive groups. And the vertebrates, when they make their first appearance as ostracoderms in the Paleozoic era, have, as Stensio has shown, all of their essential organs in a more primitive stage of imperfect evolution as compared with even the most primitive of modern fishes, and are a long way behind the higher vertebrates in the perfection and specialization of their mechanism.

IT is quite true, then, that the great branches of animal life were already distinct in the Cambrian period, with the exception probably of the Vertebrata. It is by no means the case that they are as diverse from each other or as diversified within each group as they are today. On the contrary, the most advanced and specialized groups of the early Paleozoic era find their nearest relatives in the more primitive and generalized groups of today. Again taking our phylogenetic tree as an illustration, we may say that while most of the main boughs were already distinct when the tree was half-grown, and, while some of the twigs of different boughs today may be as near to each other as any in these branches were in the Cambrian period half-way stage of growth, yet the boughs as a whole have grown farther apart, are more fundamentally separate and distinct, as well as broader in scope. It is therefore altogether erroneous to conclude that the relationships between the branches have undergone no change at all since the Cambrian.

Our picture of the Cambrian tree of life is incomplete and sketchy, it is true. It is only the hard parts of these animals that are preserved to us (there are a few rare and partial exceptions), comparatively simple in structure in these lower types, and frequently of more or less doubtful position. They are identified chiefly through their likeness to corresponding hard parts of later and better known or surviving types. For the most part we do not know whether the far more important and complex soft parts were like those of modern forms. It is in this way that they are "at once recognized" - when they are - for the history of paleontology shows many decades of dispute over the real relationship of some of of the problematic fossils.

At all events, we can hardly question that the tree has grown enormously since the Cambrian, and in view of that fact I see no reason to adopt Doctor Clark's thesis that it came suddenly into existence at some moment in pre-Cambrian time. It is too much like the Indian juggler's mango tree trick, and, while the pre-Cambrian tree is hidden under a basket, under the cloak of our utter ignorance, I do not believe that such a miracle happened, or that its growth was otherwise than according to the natural processes seen in the subsequent record of the history of life.



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The phylogenetic tree, the true pattern of the history and evolution of life. The heavy horizontal line just below the center marks the "Cambrian period"

Nevertheless there is, and will always remain, much obscurity as to the origin and early development of life on the earth, and a wide latitude for reasonable hypothesis as to its precise cause and course. I see no reason to adopt Clark's view that all the different branches originated at one time. Certainly the vertebrates must be excluded from any such hypothesis, for Stensio's studies have shown that the ostracoderms, although vertebrates, have the vertebrate organs and characters in a very rudimentary stage of development and make a very marked and significant approach to certain invertebrate groups.

IT is by no means clear that the other branches have a common origin. It is quite conceivable, and has been argued for half a century or more, that each branch may have evolved separately from inanimate matter at different times, passing through a similar but distinct one-celled stage, the identity of cell-structure in all modern animals being due to such fundamental laws of matter as make one quartz crystal like another in form and structure and composition and relationship of its component molecules. We pass here into the rarefied atmosphere of speculative hypothesis, far removed from the solid grounds of fact and record on which the paleontologist builds his lowly but tolerably permanent habitations.

And I confess that these higher flights, while interesting to watch, do not tempt me to emulation. My air-minded friends may scale the heights of fancy as they will. Those of us whose temperament is more cautious and conservative will content ourselves with admiring their ingenuity and daring, and hope that they will not crash.

The first step in making a foot brace is a plaster impression, forming a mold for casting

A plaster duplicate of the crippled foot is cast in the mold, trimmed, and a piece of metal is cut to shape for forging

In this picturesque forge shop the iron plates are made to conform to the plaster replica of the foot made in the mold

Making a plaster jacket for the back. From this cast a mold is made which serves as a base on which to build a corrective corset

Modern Rehabilitation of the Cripple

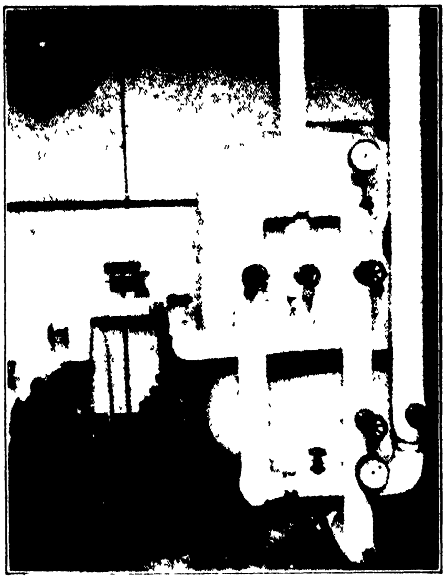
By ALBERT A. HOPKINS

UNDER the shadow of one of New York's great home developments—Tudor City on 42nd Street—is the New York Society for the Relief of the Ruptured and Crippled, which devotes itself to orthopedic relief by surgery or otherwise. In the last quarter century great advances have been made in the treatment of cripples. There was a time when the patient was dismissed with a properly fitted truss or brace. Now the tendency is to try to relieve the sufferer by surgery, or by mechanical, electrical, or therapeutic treatments. We shall here consider only the non-surgical phases.

The hospital operates a vast clinic where treatment is free to the poor, and those who can pay are asked as little as 25 cents to one dollar. Those who are better off are generally glad to pay five dollars. The hospital originally occupied the plot on which the Commodore Hotel was built. The Grand Central Station improvements called for a new hotel and the hospital was moved a few blocks to the eastward into the heart of an extremely congested district.

Orthopedic surgery deals with the rectification of congenital and acquired deformities, particularly those of the

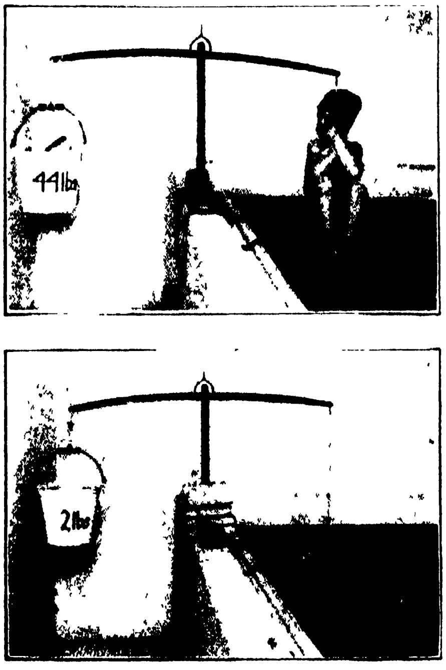
Children often have to remain long periods in the hospital for operations; a school is provided so that their mental growth will not be retarded



The water for the pool is filtered, sterilized with ultra-violet rays, and warmed to the desired point

Note that the pool is not sunk but is raised. The trolley assists in exercising the patients in the water

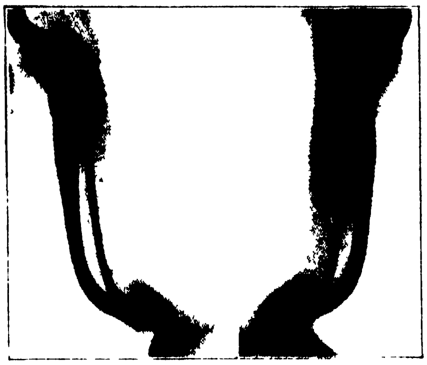
The hospital patient can rest his torso on the submerged table and can freely exercise his legs in the pool



The pool being used to demonstrate the "principle of Archimedes"; the Greek philosopher discovered the exact law which governs the loss of weight of a body in a liquid. The principle may be stated as follows: any body immersed in a liquid will lose a weight equal to the weight of the displaced liquid

The patient is suspended from the overhead trolley that encircles the pool. He can move his limbs freely without fear of sinking limbs and spine. It is a most interesting phase of surgery. Often as many as eight or ten operations are necessary before the patient is restored to society able to engage in life's struggle on a fairly equitable basis, handicapped perhaps, but vastly improved. This all takes time and it sometimes requires over a year to "make over" a child. A hospital of this kind is not a particularly cheerful place to visit, but on leaving you are filled with thankfulness that your limbs and your children's limbs are straight and that you have never been stricken by the dread infantile paralysis.

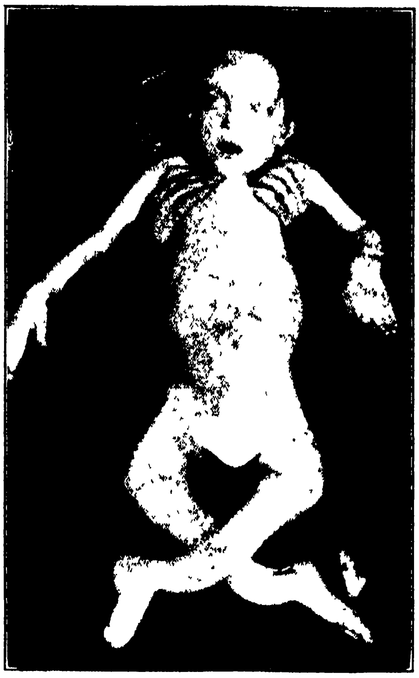
We cannot here go into the technique of orthopedic surgery with its power-driven bone tools, bone dowels, the reconstruction of bone ends and the introduction of transplanted or living tissue between the bone ends to secure movement, and dozens of other complicated and interesting operations. They can hardly be explained to the lay reader, so we will pass on to some of the other methods of treatment.



Correctional devices have always proved of great value with or without surgical relief. Foot correction occupies an important part of the work of this hospital. A cast is made of the foot and this serves as a mold in which to cast in plaster of Paris a replica of the deformed foot. This cast serves as a pattern to which a metal plate is conformed. This flat plate is cut out to form by a sheet metal working machine or nibbler. It is then contoured by blacksmiths who give a picturesque air to the shop with their time honored anvils.

IN spinal deformities a cast is taken from the patient. A plaster jacket is made on the patient by winding wet crinoline bandages in which plaster of Paris is impregnated. This drys in a few minutes and becomes very hard. If a corset is desired this jacket is slit down the front, removed, and used as a pattern.

Various devices are employed for exercising the flabby and unused muscles and even used to help teach the patient to walk once more. Therapeutic lights of all types are employed and hydro-therapeutic treatments of all kinds are given. The therapeutic pool gives much relief from the effects of infantile paralysis, arthritis, congenital hip disease, and other diseases paralyzing the muscles. In effect, the treatment in the pool is similar to that given at Warm Springs, Georgia, which has been so strongly advocated by Governor Franklin D. Roosevelt of New York State, also a sufferer.



Above: **A victim of rickets so deformed that he has never walked and his legs could not be untwisted.** ***Left:*** **X rays before operation**

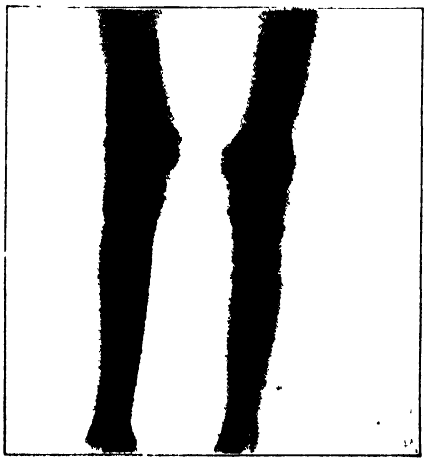
The pool might be termed an under-water gymnasium but this would not be strictly correct. The principle is one of the most elemental in physics. Since a body submerged in water loses weight in direct proportion to that of the displaced water, patients assisted by this buoyancy are able to perform exercises while in the water, which they could not possibly do when not submerged. Dr. K. G. Hansson, of the hospital staff, conceived the idea in 1914 of indoor pools of heated water for therapeutic purposes and such pools now exist in New York City, Port Jefferson, Long Island, and in Los Angeles.

Above: **The patient after operations had restored health. He can play, and his mentality has improved.** ***Right:*** **X rays after operation**

The patient is given a shower and then climbs up into the pool, which is waist-high and not sunk as is usual. The water is filtered and sterilized with ultra-violet rays. The pool is 26 feet long, 12 feet wide, and the depth varies from two to four feet. The tiles are of the "non-skid" variety to protect those who, at best, have difficulty in walking.

TWO of our illustrations show the "principle of Archimedes" worked out in actual practice. We also show a table submerged in the pool so that the patient may rest the torso on it and exercise the limbs.

Through the courtesy of Dr. Armitage Whitman of the hospital staff, we are enabled to present pictures of a boy whose whole life was changed by surgery. A social worker connected with another hospital visited a recently discharged patient who was a janitress in a tenement. There were no windows in the apartment and here the social worker found a child sitting with his legs crossed tailor fashion, as in one of the pictures. He was a victim of rickets caused by lack of sunshine, proper food, and fresh air. His legs were consequently so deformed that they could not be untwisted. He had never walked and his feet had never touched the gound. The boy was removed to the Hospital for the Ruptured and Crippled and after four operations at proper intervals his deformities were corrected and he now walks normally and his mentality is improved.



Basic Patents in Evolution—II

By WILLIAM K. GREGORY

Professor of Vertebrate Paleontology, Columbia University Curator, Departments of Anatomy and Ichthyology, American Museum of Natural History Member of the National Academy of Sciences

IN Part I of this article we saw that the striped muscle fiber, a living elastic thread that contracts when stimulated by its minute nerve fiber, was the first "basic patent" or primary invention of the complex locomotor apparatus of vertebrates. The second step was the grouping of these muscle fibers into zigzag muscle segments arranged in tandem along either side of the body. Whatever may have been the still earlier stages, it is certain that at a very early period the vertebrate body as a whole had been modeled into some kind of "stream-line" form, with a blunt, rounded head and flowing contours dwindling to the rudder-like tail. This discovery of the advantages of the stream-line body-form, both for forward locomotion and for heading up stream, may well be reckoned as the third "basic patent," although of course the reader will understand that in nature such changes are more or less continuous and more or less simultaneous, so that it is arbitrary to assign a numerical order to certain changes which may more properly be considered as details in a drift or movement whose general direction is known.

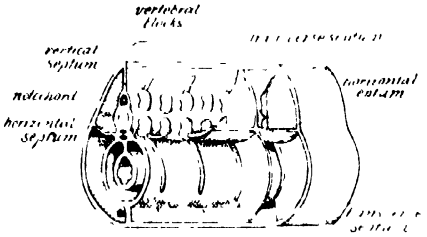


***Figure 6.* The basic patent of the vertebrate skeleton. The skeletal pieces (either cartilage or bone) arise as strengthening rods and blocks at the intersections of the longitudinal transverse and horizontal septa. After Goodrich, from "A Treatise on Zoology" (Ed., E. Ray Lankester), Part IX**

IN this connection it may be regarded as a well-established fact that the general course of evolution in the vertebrates from fish to man has been as follows: (1) a primitive chordate stage, typified broadly by the fossil ostracoderms of the Silurian age; (2) an early shark-like stage, with a relatively simple skeleton; (3) a lobe-finned stage of the Devonian age, provided with both lungs and gills and with paired paddles corresponding to our arms and legs; (4) an early land-living stage, typified by the earliest known amphibians of the Coal Measures; (5) an early lizard-like stage, known in the oldest fossil reptiles; (6) the stage of the mammal-like reptiles of the Permian and Triassic ages; (7) the early shrew-like mammals of the Triassic and Jurassic periods; (8) the first of the tree-living primates at the beginning of the Eocene epoch; thence (9) to the remotely prehuman stock that also gave rise to the Old World monkeys, perhaps at the close of Eocene times; (10) the predecessors of the anthropoid apes, some of the earliest of this lot giving rise to (11) the human line, perhaps in Miocene times.

Among other basic patents which were essential for the forward propulsion of an undulating stream-line body was the possession of a more or less elastic axial or functional backbone (Figure 6). In the first stage of its development this axis was unjointed and continuous and appeared in the form of the notochord. Later the notochord became surrounded by small blocks, clustering around the connective tissue partitions between the muscle segments, and still later these blocks combined in various ways to compose the different kinds of vertebræ that are found in amphibians, on the one hand, and in reptiles, birds and mammals, on the other.

At an early period steering was effected, as we have seen, by keel-like outgrowths from the body-wall, some of which eventually gave rise to the pectoral and pelvic paddles, which correspond to our arms and legs. At first these were supported only by rod-like pieces of cartilage that were laid down between the connective tissue mem-

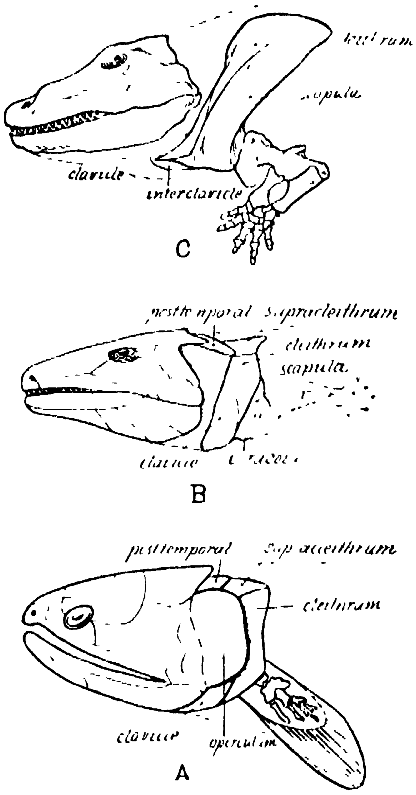


***Figure 8.* Relations of the shoulder-girdle to the skull in lobe-finned fishes and early tetrapods. (A) Lobe-finned ganoid (*Eusthenopteron*) from the Devonian period, with the pectoral girdle immediately behind the gill cover (operculum) and fastened to the skull by the post-temporal. (B) Most primitive known amphibian (*Eogyrinus*) from the Lower Carboniferous of England with the pectoral girdle still fastened to the skull by means of the post-temporal. (C) Typical primitive tetrapod (*Eryops*) from the Permian period of Texas, showing shoulder-girdle free from skull, although in life it was tied to it by muscles. Data for A from Bryant 1919; B from Watson 1924; C from Miner 1925**

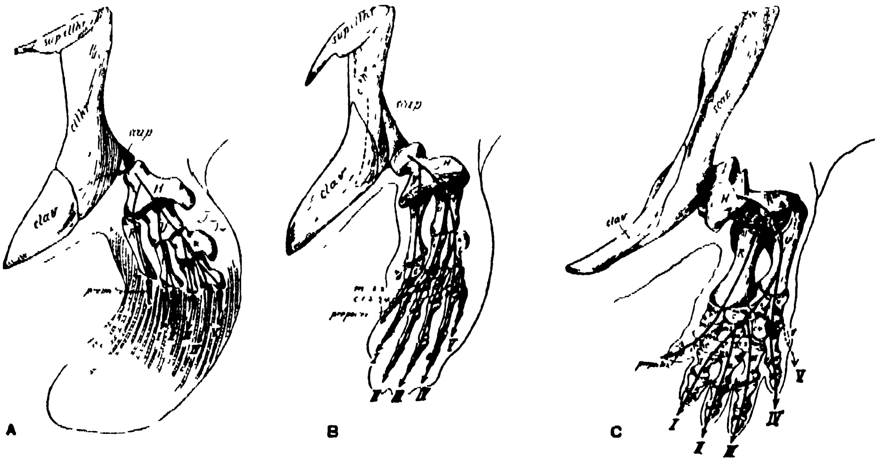


***Figure 7.* Left pectoral paddle and left half of shoulder-girdle in (A) lobe-finned fish, (B) hypothetical intermediate form and (C) early amphibian. After Gregory. In each view the limb is shown supporting the body weight**

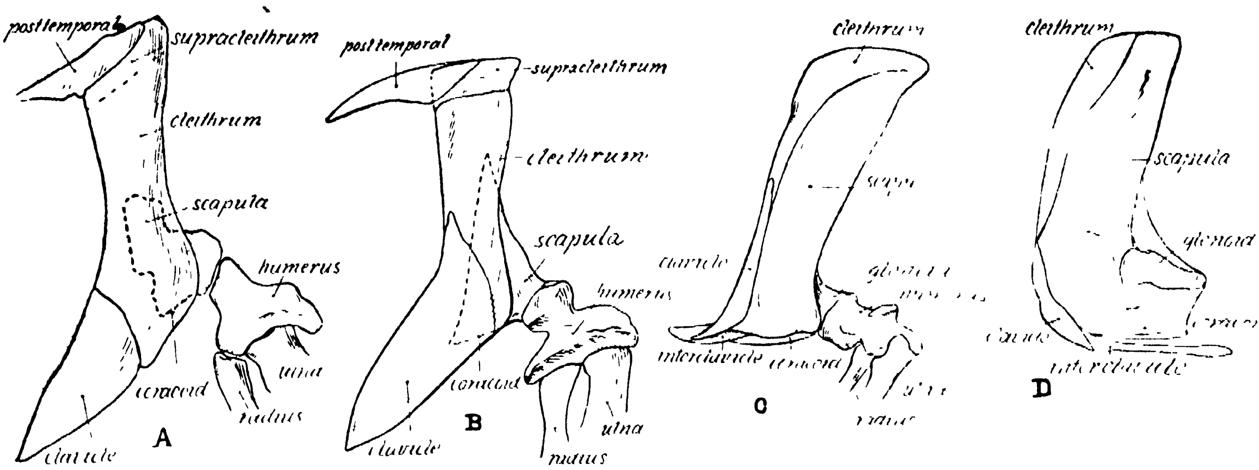


Figure 9. **Four stages in the evolution of the shoulder-girdle. (A) Left half of shoulder-girdle of lobe-finned fish (*Eusthenopteron*) showing the primary shoulder-girdle (scapulo-coracoid) behind and mostly on the inner side of the secondary, outer or dermal girdle (clavicle, cleithrum, etc.). (B) Left half of shoulder-girdle of very primitive amphibian (*Eogyrinus*), showing initial enlargement of the inner girdle, (scapulo-coracoid), but with the entire outer girdle still functional. Data from D. M. S. Watson. (C) Typical early amphibian (*Eryops*), showing great enlargement of the inner girdle (especially the scapula), reduction of the clavicle and cleithrum, and disappearance of the supraclavicle and post-temporal plates. (D) Early primitive reptile (*Diadectes*), showing enlarged primary girdle (scapulo-coracoid) and reduced outer or secondary girdle (cleithrum, clavicle, interclavicle). The coracoid plate is undivided. Details chiefly from Gregory, 1928**

branes that surrounded adjacent muscle segments. In the sharks the pectoral paddles are supported by a fan-like system of cartilaginous rods and basal blocks, which as a whole correspond to the skeleton of our hands and arms. By the time of the lobe-finned fishes of the Devonian period (Figure 7, A,) the skeleton of these pectoral paddles had begun to foreshadow the "tetrapod" or four-footed, land-living type, but they were still unable to support the full weight of the body on land. When at last certain of these air-breathing, lobe-finned fishes ventured to crawl out of the foul pools, in which in the dry season they were liable to suffocation, their pectoral paddles were drastically remodelled into the five-fingered tetrapod type (Figure 7, C) which even man retains in a somewhat modified form.

In a crawling amphibian or crocodile or in a running mammal, after the body is lifted up by the straightening of the limbs it falls forward, passing over an arc the radius of which is measured by the distance from the shoulder-joint to the base of the fingers. The pectoral and pelvic girdles are essential structures not only in transmitting the thrusts caused by the straightening of the limbs, but also in acting as slings for the support of the body. The pectoral girdle in front view is a U-shaped sling, consisting on each side of an inner core, the scapulo-coracoid arch, and an outer layer of bony sheathing plates, found in all fishes above the shark grade as well as in the earliest land-living animals up to the mammal-like reptiles.

In the air-breathing, lobe-finned fishes of the Devonian period the shoulder-girdle was a crescent-shaped structure that separated the gill-chamber in front from the muscular flanks of the body behind it (Figure 8, A). It consisted of two layers, an inner or primary shoulder-girdle, which

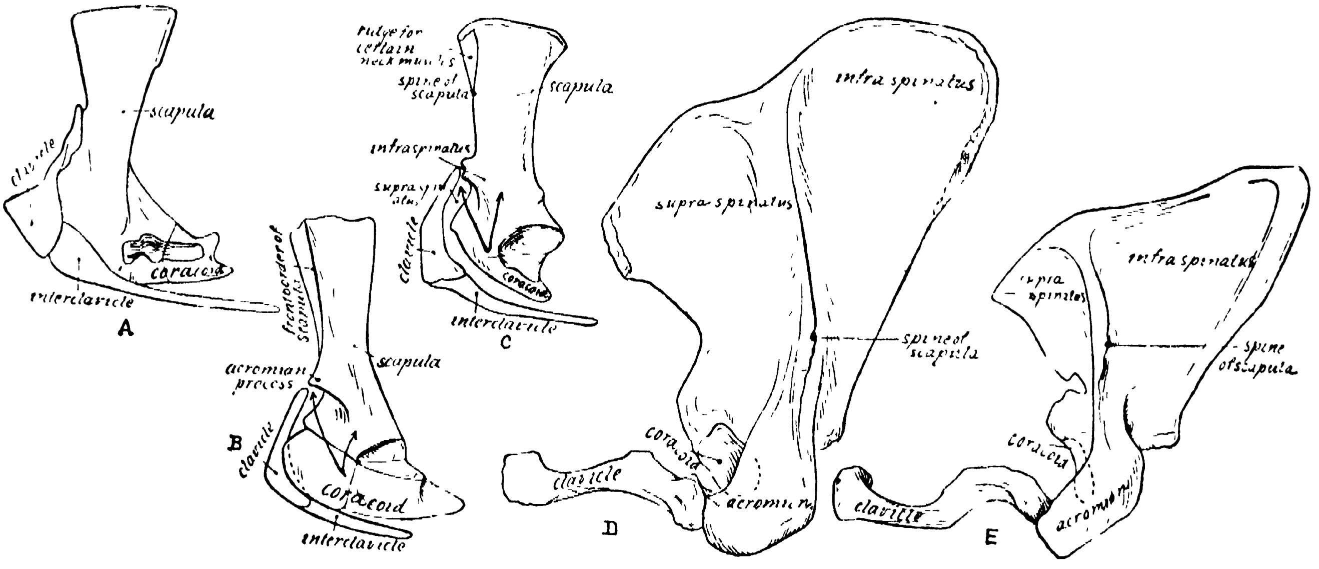


Figure 10. **Further history of the shoulder-girdle. (A) Typical early reptilian type, after the loss of the cleithrum. The coracoid plate is now subdivided by a vertical suture into two parts, of which the posterior one later gives rise to the coracoid process of mammals. (B) First phase of the mammal-like reptile stage, in which the front border of the scapula is reflected outward to form the "spine of the scapula." The arrows show the directions of the two upwardly-growing divisions of the supracoracoid muscle, which give rise to the supraspinatus and infraspinatus muscles of mammals. (C) Second phase of the mammal-like reptile stage, showing further progress toward the mammalian condition, in which the "acromion" projects from the spine of the scapula and the coracoid plate is reduced in size. (D) Shoulder-girdle of the gorilla (left half), showing complete agreement with that of man except for minor differences in the proportional size of certain parts. (E) Shoulder-girdle of man (left half). Of the original two-layered girdle the clavicle represents the outer or dermal girdle, while the scapula represents the primary girdle. The coracoid is reduced to a hook. After Gregory, 1928**

was more or less crescent-shaped, with the concave side directed forward, and a surface layer of bony plates following the same general direction and fastened above to the hinder outer corner of the skull. At first the outer or sheathing plates of the pectoral girdle predominated but when the weight of the body came to rest on the bent pectoral paddle, the stresses on the inner or primary shoulder-girdle increased, so that the scapular blade (Figure 9) grew upward and finally (Figure 10) became the dominant member of the series.

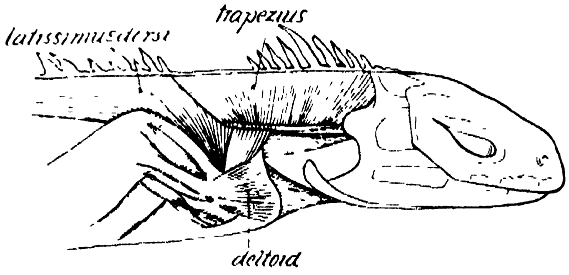


Figure 11. **Musculature of the shoulder-girdle of a primitive reptile (*Sphenodon*). From Gregory and Camp, 1918, after Fürbringer, 1900**

In the course of many millions of years the outer dermal girdle as a whole gradually lost its functional importance, so that in the higher mammals several of its plates, namely the interclavicle and the cleithra of either side, have disappeared entirely. In the primates, including man (Figure 10, D, E) only the clavicles or collar bones remain as souvenirs of the outer or dermal shoulder-girdle; this was because the ancestors of man were tree-living forms in which the clavicles were important in suspending the weight of the body from the arms.

Meanwhile the inner or primary shoulder-girdle has likewise undergone many important changes (Figure 9). In the lobe-finned fishes (Figure 9, A) its lower prong, the coracoid, was not large. In the early amphibians it has broadened out into a large semicircular plate. In the mammal-like reptiles (Figure 10, C) it finally diminishes in size, while the scapular blade above it meanwhile becomes dominant; in the mammals (Figure 10, D) the coracoid undergoes progressive reduction and finally (Figure 10, E) dwindles into the coracoid process of the human scapula.

THE scapular blade has also been greatly modified and its history furnishes a beautiful example of the fact that during the course both of individual growth and of evolution, bone is not a rigid substance but responds to the changing forces around it by laying down "trabeculæ," or tracts of bone cells, in directions that stiffen the bone against the stresses developed within it. Thus the form of the bone changes from within in adjustment to external stimuli. In the lobe-finned fishes (Figure 9, A) the scapula is relatively small, but when the pectoral paddle had to support the weight of the body on the ground the stresses that were developed in it increased and it enlarged accordingly (Figure 9, B, C). At first its function was chiefly for the anchorage of the muscles that suspend the body, including those that run either downward and backward to the ribs or downward and forward to the sides of the neck vertebræ. The inner side of the scapula also serves as the anchor for a part of the subscapular muscle which tended to draw the humerus inward; its outer surface (Figure 11) was partly covered by the great deltoid muscle running downward to the outer side of the humerus, while its upper border served for the origin of muscles that passed inward to the top of the backbone. Thus the scapula or upper part of the primary shoulder-girdle becomes the platform for many important muscles that transmit the thrust of the backwardly extended humerus upward and forward, or prevent the collapse of the scapula upon the humerus, or hold up the body when the opposite limb is lifted from the ground.

THE subsequent changes in the scapula were dependent upon the change from crawling, with the elbows sprawling outward, to running, with the hands under the body and the elbows drawn in to the sides (Figure 12). When this happened, certain muscles on the outer side of the coracoid plate found themselves in a disadvantageous position and they accordingly gradually shifted upward (Figure 10, B, C), invading the outer face of the scapula from below and giving rise to the supra- and infraspinatus muscles of mammals. These muscles assist in moving the humerus back and forth but they are even more essential in cooperating with the subscapular muscles in preventing the collapse of the scapula upon the humerus. However, the original front border of the scapula had already been curled outward (Figure 10, B, C) by the stress of surrounding muscle and had given rise to the so-called "spine of the scapula" of mammals. Thus when the invading muscle from the supracoracoid mass grew upward, the rear fork passed behind the spine of the scapula and occupied the post-spinous fossa, while the front fork passed in front of this spine.

It has frequently been observed by all students of the skeleton of mammals that the presence of muscles and their tendinous sheaths frequently cause the upgrowth of ridges and crests from the bone that supports them. Consequently when the front fork of the upgrowing supracoracoid muscle found itself pressing against the scapula, it was soon able to evoke a supporting crest, which finally gave rise to all that part of the mammalian scapula which lies in front of the scapular spine. Hence we, in common with other mammals, owe the front part of our shoulder-blade to our remote ancestors, the immediate successors of the mammal-like reptiles, who first developed a ridge or crest in front of the spine of the scapula for the support of an upwardly prolonged slip of the old supracoracoid muscles.

When the limbs were drawn in at the sides (Figure 12, B) the joint between the humerus and the scapula was pulled outward and the coracoids were drawn out into narrow rods; then these lost their attachment to the breastbone or sternum and dwindled away into the hook-like coracoid process. This was retained only because it gave anchorage to the powerful biceps and coraco-brachialis muscles which flex the forearm.

In brief, the pectoral girdle of the ancestral fish served as the rear wall of the gill-chamber and as the anchorage for the pectoral paddles and body muscles. It consisted of an inner and an outer series of plates. Under the changed conditions of locomotion on land the inner or deep parts of the pectoral girdle gained the ascendancy and the outer plates finally became greatly reduced. Man inherits his shoulder-blade, or scapula, together with his now vestigial coracoid, from the inner series of the pectoral girdle of the fish; his clavicle, or collar-bones, represents its dermal plates.

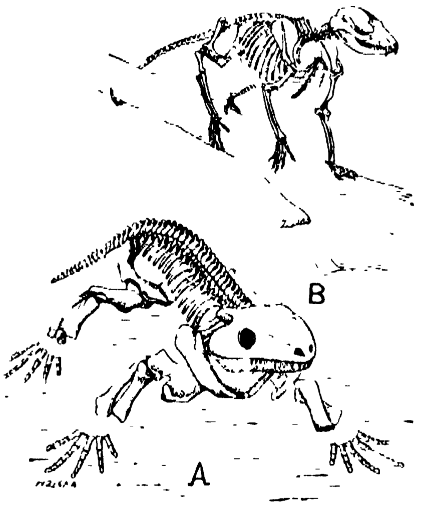


Figure 12. **Contrast between primitive reptile (A), with sprawling limbs and typical mammal (B), with limbs drawn in at the sides**

Thus new advances require the sacrifice of old devices and the working out of new basic patents.

(To be concluded)

A Fish Factory At Sea*

THE outfitting of a ship, formerly in operation in the Orient, as a floating fish factory, has just been completed in England and she has left for a cruise in the waters off southwest Africa. The *Seapro*, as she was renamed, is provided for dealing with the many classes of fish in that locality and a fleet of motor boats for doing the actual fishing. These boats, it is anticipated, will bring to the parent ship from 60 to 100 tons of fish every day. Some of the fish that will be utilized are fit only for conversion into cattle, pig, and poultry feed; some are valuable for their oil content; others have livers that provide a valuable medicinal oil; and some are worth putting in cold storage for sale at a convenient market.

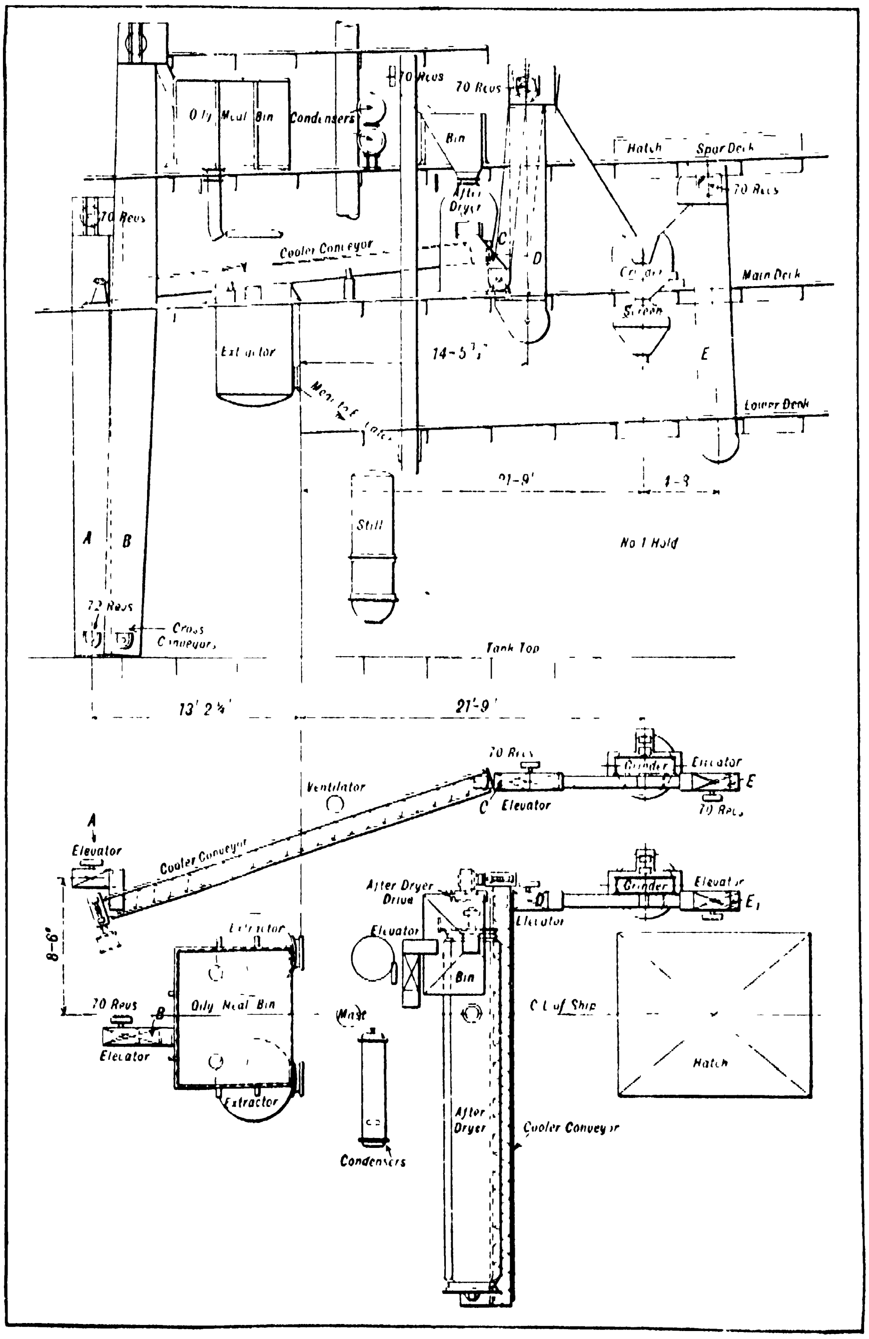
In such an enterprise as that of the *Seapro*, one of the first matters to be borne in mind is that the average content of water in fish is from 70 to 75 percent and that the ship must not be encumbered with so much valueless material. As a consequence, the greater part of the catch must be passed through dryers to drive off this moisture.

The coarser kinds of fish will be hoisted on deck from the fishing boats and dumped into hacking machines, one on each side of the vessel 'tween decks. These machines comprise two pairs of rolls made up of a series of toothed plates. The rolls rotate at different speeds and tear the fish into small pieces. The hacked material is then passed through a sterilizing chamber where the albumen is coagulated and any noxious bacteria killed by being subjected to steam. Then it goes into the drying machines, one of which is on each side of the ship.

THE drying is done in four parallel cylinders which are steam-jacketed. In the drying process, large quantities of steam are driven off and this contains a certain proportion of vapor of an offensive nature. This steam is, therefore, collected and passed through a series of three condensers which are cooled by circulated sea water. The condensate is discharged overboard. There remains a small amount of uncondensable gas which must be done away with, so this is sent up the boiler funnel for complete burning.

From the dryers, the meal is discharged into elevators, one of which is for "white" fish and one for oily fish. The white fish meal goes up elevator A—see diagram—to a cooler, then through a magnetic separator for taking out any scrap metal, into a grinder, and finally into bags ready for the market. The oily fish meal goes up elevator B into a large bin on the spar deck, from which it drops into one of two oil extractors, or digesters, on the deck below. Trichlorethylene, which is non-inflammable and recoverable in its entirety, is used for dissolving the oil. After the first wash of solvent has become saturated with oil, it is drained off and distilled. The condensers shown in the diagram condense the vaporized solvent. When all the oil has been recovered from the meal, steam is introduced into the extractors to recover any remaining solvent. The oil-free meal is then passed through the same process of grinding and separation as the white fish meal. The fish oil that has been extracted is pumped from the evaporator into tanks or barrels. The operations are all automatic, the machinery and conveyors being driven by electric motors.

In the after part of the ship there is a complete plant for making tins, boiling and canning such sea foods as crayfish; and another plant for boiling out the oil of fish livers. The refrigerating plant for carrying fine food fish to market is of normal design.



Side and top views of the principal equipment on the *Seapro*

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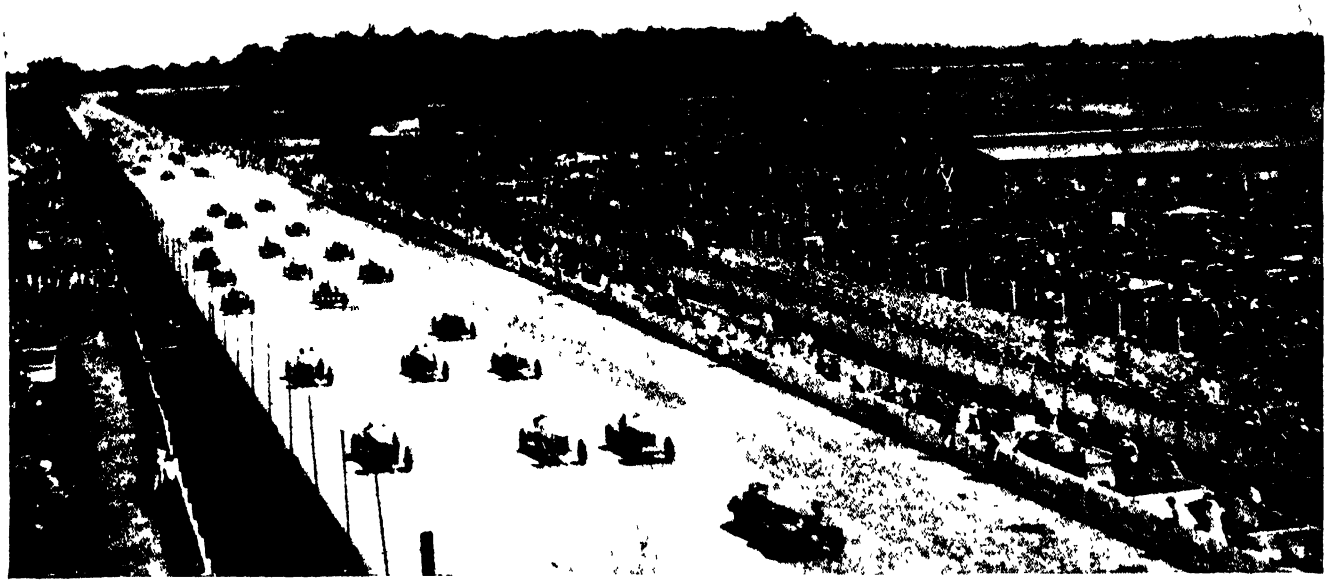
*Abstracted, by permission, from *The Engineer*, London. Illustration courtesy *The Engineer*



The start of the 1930 Indianapolis race. The cars in this, the first lap, are being paced by a stock Cord front-drive car. This lap is not a part of the race but is run only to bring the cars across the starting line at 75 miles an hour

Racing Cars of 1930

By WILLIAM F. STURM

A STUDY of the 1930 Indianapolis race is especially interesting in view of the greatly changed conditions under which the race was run. The race is run on a four-cornered track, 2½ miles around, and paved with vitrified brick. The four corners were built for a speed of only 90 miles an hour average for the lap. They are banked only 16.66 degrees for the first 50 feet from the lower edge of the track, and 36.66 degrees for the outer 10 feet - the rim where cars never run except in case of a near smash with another car.

One thing that made for a good race this year one easy on tires especially was that the temperature at noon was 58 degrees, with a good breeze blowing, against the 87 degrees last year.

A resumé of the first five places in the race, with last year's average for each, follows:

First Billy Arnold, Miller-Hartz, front drive, eight cylinders, 150.5 cubic inches displacement; 100.448 miles an hour (last year's average, 97.585).

Second—William Cantlon, Miller-Schofield, rear drive, four cylinders, 183 cubic inches displacement, 98.054 miles an hour (last year, 95.596).

Third—Louis Schneider, Seal Fast, rear drive, eight cylinders, 121 cubic inches displacement, 97.241 miles an hour (last year, 93.699).

Fourth—Louie Meyer, Sampson, rear drive, sixteen cylinders, 203 cubic inches displacement, 95.253 miles an hour (last year, 93.541).

Fifth Bill Cummings, Duesenberg, rear drive, eight cylinders, 243.5 cubic inches displacement, 93.579 miles an hour (last year, 88.792).

SEVERAL matters rather definitely decided by the race were:

That the rules banning the supercharger and other so-called speed adjuncts were not destructive to the speed average of the race.

That stock cars, or modified stock cars, did not enter the race in as large numbers as expected.

That the highly specialized racing car is still supreme, winning, as it did, the first four positions; or, if we include the changed stock motor in fifth place, winning the first seven places.

That while these highly-specialized cars will continue to be built, the modified stock-car engine made a showing that warrants the belief that it will appear in next year's race in greater numbers.

A year ago the Indianapolis Motor Speedway Corporation issued a radically new set of rules for the 1930 race. For four years the drivers had been piloting 91½ cubic-inch racing cars equipped with centrifugal type superchargers and having one-man bodies. (See SCIENTIFIC AMERICAN, January, 1930.—*Editor.*)

The rules for this year's race provided for the abolition of the supercharger; limited carbureters to two; limited poppet valves to two per cylinder; raised the piston displacement limit to 366 cubic inches; and made mandatory the two-man body and a minimum weight limit of 1750 pounds, with the further provision that cars must weigh 7½ pounds per cubic inch of displacement.

The drivers naturally made a great outcry. Racing had not been especially good for several years and the new rules compelled the drivers to spend from 2000 dollars, which was the minimum price a new body with gas tanks could be built, to 10,000 dollars, or 15,000 dollars for a completely new car. The rules meant even more than that to the driver—they meant that the little 91½ cubic-inch cars were practically obsolete, since other tracks would, in the main, follow the Indianapolis rules.

A study of the entry list of the race shows that there were 10 four-cylinder, 2 six-cylinder, 23 eight-cylinder, and 2 sixteen-cylinder cars. It is an interesting note that the winning car was an eight-cylinder, built up and owned by Harry Hartz, but not driven by him. Hartz is recognized as one of the cleverest men in the business when it comes to getting cars ready for an Indianapolis race. He himself has won three second places and two fourth places in years past, but he is now definitely out of the driver's seat.

A further note of interest is that the race was won for the first time in its history by a front-drive racing car, with a front-drive mechanism that is practically a duplicate of that in the most popular front-drive car in America. Another front-drive won sixth place, while still another won seventh.

The average of the race 100.448 miles an hour was the highest of any 500-mile race except one: that won by Peter DePaolo in a Duesenberg Special in 1925, when the average was 101.13 miles an hour.

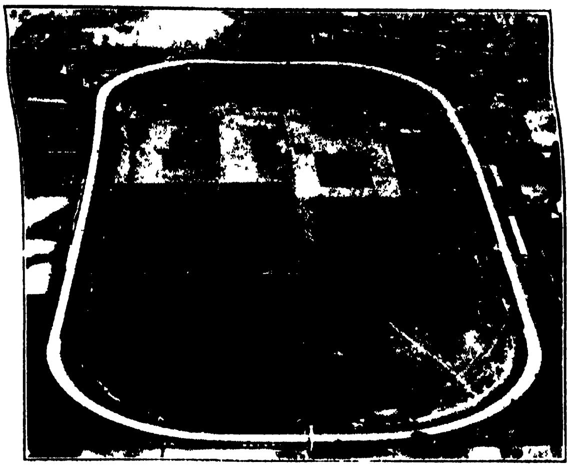
THE race brought back into racing the four-cylinder car, and evidently it will stay because of its good showing. Ten of the drivers went to the four-cylinder because these motors could be obtained with large piston displacement from a west coast maker who knew engines thoroughly. The fact that the limit of two carbureters might make carburetion difficult for multi-cylinder cars no doubt was another factor, as the drivers of the fours were certain of good carburetion with two carbureters to four cylinders.

Louie Meyer's carburetion on the sixteen-cylinder Sampson Special, however, with two downdraft carbureters, was very good; so good, in fact, that he had the greatest acceleration on the track and qualified his car at 111.290 miles an hour for four laps of the two and a half mile track, next to the fastest qualification made. The racing drivers handled their carburetion well on the eights.

In qualification, Arnold, the race winner, averaged 113.268 miles an hour. He took the lead after Louie Meyer and his Samspon Special had held it for two laps and after that was never headed. Arnold stopped in the 111th lap for right and left front tires, oil, and gas, taking three minutes. He made no more stops until the finish of the race, and had no mechanical trouble.

William Cantlon, second place winner, qualified his car at 109.810 and was the third highest qualifier. He stopped at the pits in lap 97 to take on a right front and right rear tire, water, gas, and oil, and gave up his wheel to Herman Schurch, relief driver. The time at the pits was 2 minutes 15 seconds. Schurch stopped in lap 151 for 25 seconds and Cantlon took the wheel.

Louis Schneider, in his Jones-Maley Special, had no mechanical trouble. He stopped at his pit in lap 102 for 1 minute 20 seconds for a right rear tire, gas, and oil. In lap 184 he stopped for 10 seconds for gas and to tighten up a shock absorber.



The round-cornered, brick track on which the races are run, as it appears from an airplane

Arnold's car develops approximately 150 horsepower; while Cantlon's develops approximately the same. For those interested in gear ratios and engine compression, Cantlon's four-cylinder car pulled a 3.9 to 1 gear and its compression ratio was 10 to 1. This is the highest compression ratio used in the race, the average being between 6 and 7 to 1. The gear and compression ratio of the winning car could not be ascertained.

ARNOLD wound his engine up to a peak of about 6200 revolutions per minute. Cantlon's peak was about 5000, while Schneider, the third man wound his to between 5600 and 5800. Louie Meyer wound his sixteen-cylinder car to a top of 6100.

The Sampson Special of Louie Meyer is unique in construction. Its two banks of eight cylinders are placed vertically and each has its own crankshaft, cooling system, and oiling system, only the gasoline system being a common one. Even the radiator is separated in the center, there being no connection between the two sections. Each water cooling system holds approximately four gallons. Each of the two crankshafts has a gear on its front end and these two are connected at the front of the motor to a like gear on a shaft which runs between the two banks back to the transmission. The motor was reversed, to obviate the necessity for a change in the transmission and rear-drive assembly. It had a total displacement of 203 cubic inches and was the highest priced car in the race, representing an investment of approximately 16,500 dollars.

The outstanding performance in the race was that of a Jones-Stutz Special. This car was entered by Milton Jones, a private owner, of Cleveland, Ohio, and was driven to tenth place by L. L. Corum. It was stock in every particular except that its oil and gas tanks were made larger for the sake of fewer pit stops for fuel and oil, and the fenders and running boards were removed.

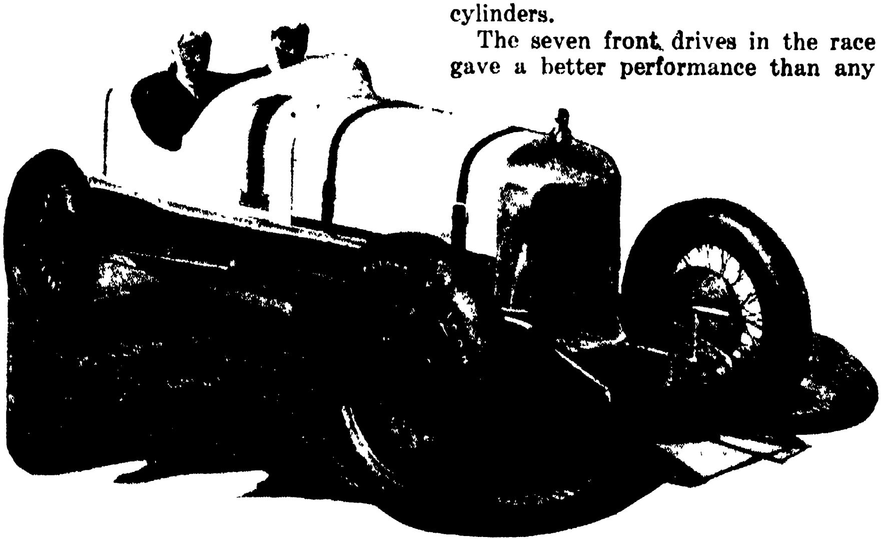
THIS car weighed 4600 pounds at the starting line. It ran the entire race without the hood being lifted except to add two quarts of oil. In spite of its great weight it made no tire changes, the four original ones going through in perfect shape and with so little wear that they evidently were good for thousands of miles more of ordinary usage. The tire wear and performance of the car is a tribute to the excellent balance of the car as well as its mechanical perfection. This is the best stock car performance the 500-mile race has ever seen, even in the days when modified stock car racing was the vogue.

It was unfortunate that the duPont Special, the only factory-entered car in the race, had a smash-up and was put out of the race. This car's performance would have been watched with interest because of its near-stock set-up.

Bill Cummings' Duesenberg Special had a motor that formerly was in a Duesenberg stock car. A new head, not stock, was made for the race.

Dave Evans' Jones-Maley

Billy Arnold, the youthful winner of the 1930 Indianapolis Speedway classic. His Miller-Hartz two-man racing car is the first front-drive to have won this annual race front-drive was, in part, the second front-drive of modern times, it being one of the two cars built by Harry Miller for the 1925 race at Indianapolis. It is a peculiar commentary that it sat in its garage throughout the race in 1925 because DePalma, Duray, Bennie Hill, and other big drivers of that time decided they did not wish to handle it through a race.



Meanwhile, the other front-drive went ahead, driven by Dave Lewis, Harry Miller's brother-in-law, and won second place in the race at 100.82 miles an hour faster than first place in this year's race.

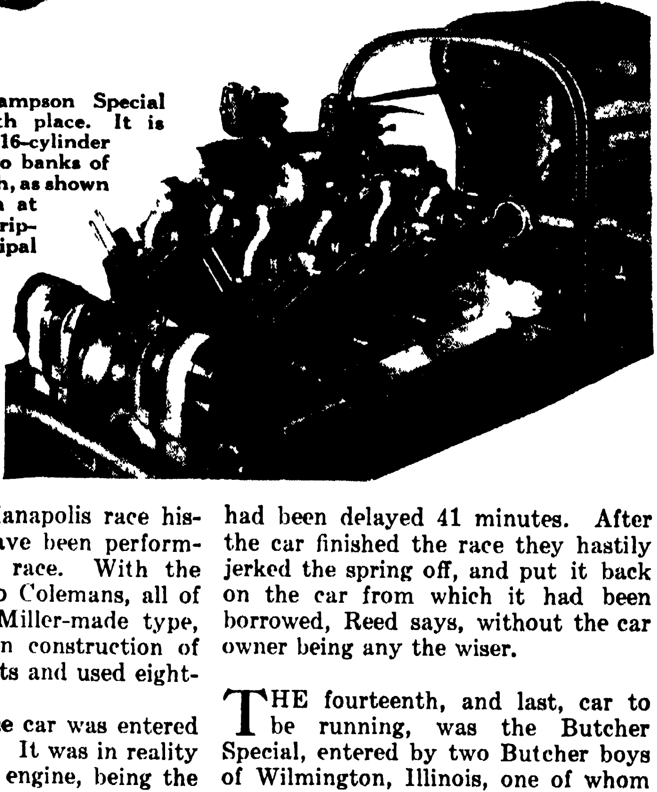
In winning seventh place with a Coleman front-drive, the entry of the Coleman Motors Corporation, of Littleton, Colorado, Phil Shafer demonstrated the correctness of the theory of the Coleman. Its front end embodied many of the features of the Coleman four-wheel-drive truck on a smaller scale. The Coleman broke all racing tradition and calculations by carrying most of its motor weight unsprung, the front motor support being on the front axle. The Coleman differs from other front drives in that it has only one front axle, the driving one, and not a subsidiary one to carry the weight as is the case with others.

SHAFER, in averaging 90.921 miles an hour with his car, which has a top speed of about 103 miles an hour, miscalculated the speed at which the race would be run and held resolutely within striking distance of 93 miles an hour, his estimate of the winner's average. The motor used in the Coleman was a 183 cubic-inch Miller four-cylinder. Another Coleman, driven by Lou Moore, was in a crash and did not finish the race.

The car to finish in eighth place has a stock Studebaker eight President motor; and many of its chassis parts, including the frame, are stock. Snowberger's performance was noteworthy. His top speed was approximately 104 miles an hour but a broken shock absorber stud caused him to decrease his speed and he lost his chance to win.

Leslie Allen's Allen-Miller Products car was strictly a racing car, with a four-cylinder Miller engine of 183 cubic inches. The remarkable part of Allen's average of 85.749 miles an hour was that he put a valve through one of his pistons, with more than 100 miles to go, yet he drove to the finish at a speed of 80 miles an hour on three cylinders.

The seven front drives in the race gave a better performance than any other group in Indianapolis race history, where they have been performing since the 1925 race. With the exception of the two Colemans, all of them were of the Miller-made type, basically identical in construction of their front-drive units and used eight-cylinder engines.



Louie Meyer's Sampson Special which took fourth place. It is powered with a 16-cylinder motor built in two banks of eight cylinders each, as shown in the illustration at the right. A description of its principal features is given in the text. In it, Meyer made an average speed for the race of 95.253 miles per hour, and had no trouble with his carburetion

The eleventh-place car was entered simply as a V-eight. It was in reality an Oakland V-eight engine, being the only V-eight in the race. It made a highly creditable showing for a motor that was all stock except its pistons, according to its entrant, Ira Vail. It had qualified at 97 miles an hour.

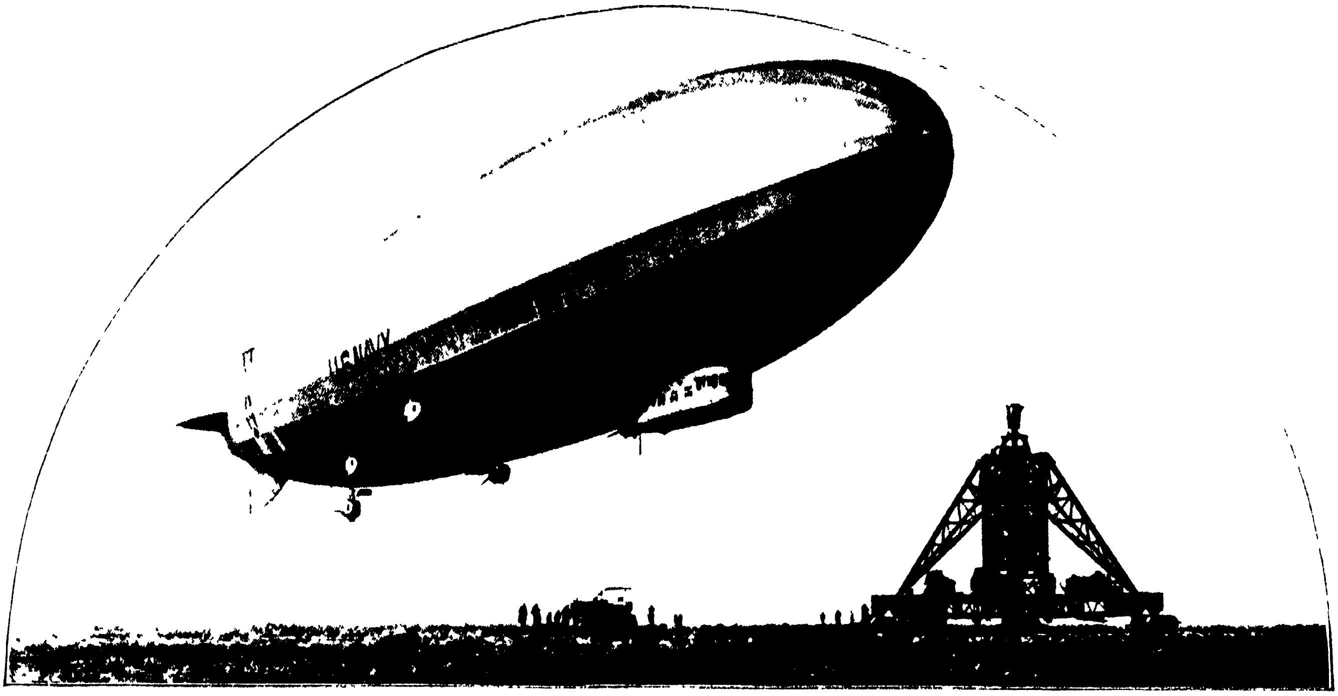
The twelfth car to finish, the Maserati eight, driven by Letterio Cucinatto, of Italy, was the only foreign car to finish, the other one, a sixteen-cylinder Maserati, stopping in the early part of the race with motor trouble.

The car running in thirteenth position was a Fronty Special. This little car, made up of Model T and Model A Ford parts, did especially well. Its transmission and clutch are Model A. The engine is Model T, with special Fronty head. The crankshaft, connecting rods, and pistons are non-stock. The chassis is Model T, including the transverse springs, front and rear. This car qualified by doing four laps of the track at 97 miles an hour. It was running the race at between 85 and 90 miles an hour, when the technical committee member in charge of the recording of car conditions, saw that the eye of the front spring was broken off when the car came in for gas. The driver explained that it had been that way for an hour and, beyond making the car difficult to handle on the turns, no serious difficulty could result. The technical man was obdurate, however, and insisted that something be done. Accordingly, Stanley Reed and Tom Mulligan, entrants of the car, ran into the infield at the track and turned the first Model T Ford they came to up on its side and took off the front spring. They put it on their car, after the Fronty had been delayed 41 minutes. After the car finished the race they hastily jerked the spring off, and put it back on the car from which it had been borrowed, Reed says, without the car owner being any the wiser.

THE fourteenth, and last, car to be running, was the Butcher Special, entered by two Butcher boys of Wilmington, Illinois, one of whom drove while the other acted as mechanic. This car was a big Buick motor mounted in a small Buick chassis, cut down to a wheelbase that would do for racing conditions. It ran throughout the race, but at a very low average.

There were 37 cars entered in the race, but only 14 were running at the close of the race.

There were numerous car failures due to such causes as cracked cylinder heads and broken wrist pins, gas tanks, connecting rods, valves, water jackets, and clutches. Several serious smashups occurred.



The *Los Angeles* makes ready to tie up at the new mast

Mooring Dirigibles Mechanically

New Stub Mast and Other Equipment at Lakehurst Facilitate Mooring and Housing

A FEW weeks ago there occurred at the United States Naval Air Station at Lakehurst an event which marked the passing of another milestone in the development of rigid airships. The *Los Angeles*, having been landed from flight, was secured to mechanical devices near the hangar and with about 60 men attending various stations on this equipment the ship proceeded under mechanical power to her berth in the hangar while over 200 other members of the ground crew stood by in unaccustomed leisure and watched this performance in which they have usually had to participate so forcefully with brain and brawn largely the latter. The first demonstration of practically the full mechanical system for docking airships had been successfully conducted.

Every since the inception of American development of the rigid airship, it has been realized that the field of terminal facilities and other auxiliaries represented a weakness in airship operation. The success of airship operation, both military and commercial, depends very largely on the achievement and provision of adequate, efficient, and economical terminal facilities. From the very beginning airships had been handled in and out of sheds by groups of men placed at strong points of the ships to haul against direct winds and gusts, man-power, of course, having the virtue of being highly flexible. As the size of ships increased, ground crews grew to several hundred men.

Lakehurst, being rather unfavorably situated from a meteorological standpoint, has from the very beginning impressed our airship personnel with the fundamental necessity for improvements in airship mooring and handling.

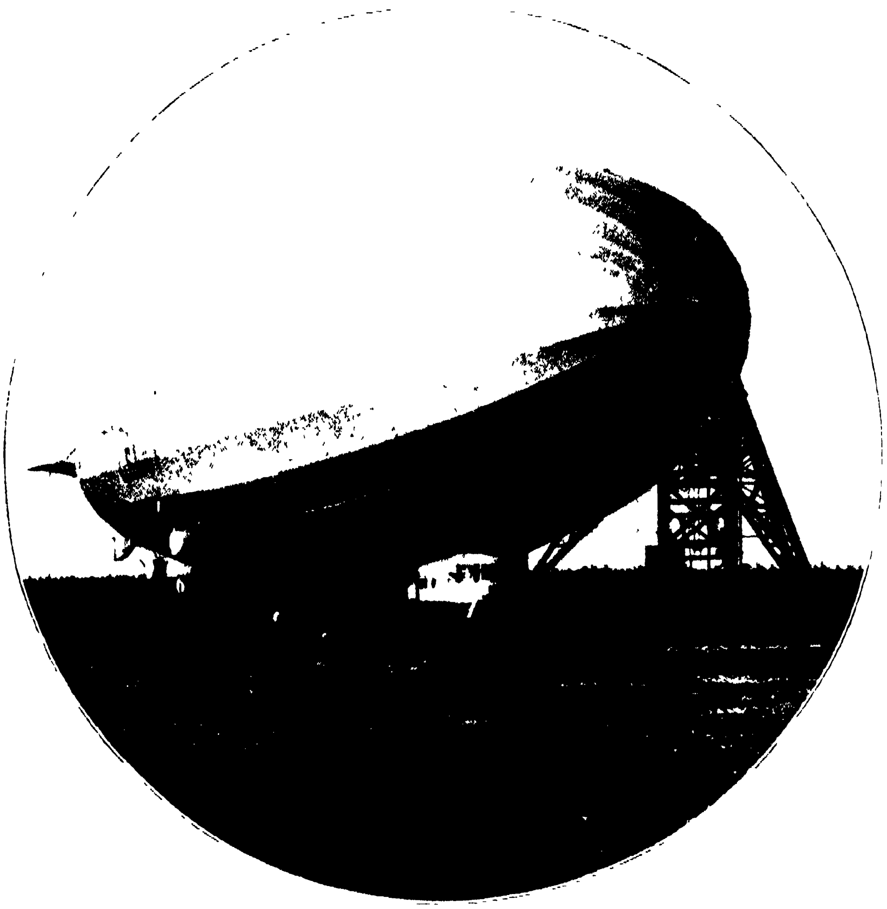
SHORTLY after the World War, the British developed an airship mooring mast which materially added to airship progress in making it generally possible for airships to remain at the mast until favorable conditions permitted housing them without difficulty, should housing be desired. One British airship remained based on a mast for a period of about six months.

However, this "high" type of mooring mast is not a "cure-all" for every airship need. Large ground crews are needed at some time or another when housing or unhousing becomes necessary. Consequently some unit other than the high mast had to be developed.

The method of housing and unhousing airships at first was to employ only men in groups about the ship in a manner similar to the tugs around an ocean liner. Then there were added "docking rails" projecting along the sides of the hangar and extending out on to the field and over which there traveled trolleys, two on a side, attached to the ship by suitable lines. Additional groups of men steadied the ship against the wind as she had to be moved parallel to the hangar. Such was the extent of the "airship handling project" when taken up at Lakehurst.

The mooring and handling problems resolve themselves into three phases: (a) landing the airship from flight; (b) mooring the ship out or "anchoring" it to ride, ready for flight, as a surface vessel anchors or swings to a buoy; (c) housing or unhousing the airship just as a surface vessel docks or undocks. The problem was one of combining, if possible, these three functions in one set of equipment and making that equipment as efficient and simple as possible. Two phases of this problem have already been proved practical; the third is still in the process of development, but present indications give promise of early solution.

In landing from flight, an airship formerly proceeded over the landing point and was pulled to the ground by man-power using ropes dropped from



Anchored to the stub mast, the *Los Angeles* will safely outride winds of more than ordinary velocities. The cabin, it will be noted, is close to the ground

her bow. In landing to a mooring mast the process is that of being pulled down against her buoyancy by mooring wires dropped from her bow and connected to corresponding ground wires which are then hauled in by power-driven winches. One of these wires pulls the ship downward while two others, leading aft at an angle to the ship, steady her against yawing tendencies arising from gusty wind conditions. These same two wires also prevent the ship from over-riding the mast and thereby possibly fouling her hull against the mast. By means of these three wires the steel cone on the nose of the ship is maneuvered into a steel cup on top of the mast where it is firmly locked.

ALTHOUGH this original method of mooring to a mast has been successfully used a great many times, it does not fully overcome the irregularities of the wind. It has been demonstrated repeatedly that there exists the necessity for providing an additional force to overcome the tendency of vertical gusts to drive the ship downward. Such vertical tendency may, of course, be overcome to some extent by making the ship more buoyant, but there is a practical limit to this measure and, therefore, there exists the necessity for providing a corrective force outside the ship.

The solutions of these several problems worked out at Lakehurst center largely in the demonstrated success of a low or "stub" mooring mast some 60 feet in height as opposed to 171 feet and even 201 feet in modern examples of the "high" mast.

The principal unit employed in the new mechanical system at Lakehurst is a low mobile mast capable of movement over the ground. This mast not only acts as the principal unit of the handling equipment, but also serves as a mooring device to which the ship may be moored for indefinite periods. It incorporates a telescopic feature enabling its height to be adjusted to suit different airships.

To utilize the mast for "anchoring" purposes there is provided a mooring site or circle in the precise center of which the mobile mast can be placed. Surrounding the mast is a circular, standard-gage railroad track on which runs an especially devised car to which the after portion of the airship is secured. In this way the mooring airship is secured at two places, that is, with the bow in the mooring mast cup and the after portion of the ship attached firmly to the car which moves with great facility along the circular railroad track thus allowing the ship to answer fluctuations in the wind directions just as does a weather-vane.

At this low or stub mast, which is an American idea, the lower part of the airship is held within a few feet of the ground, thereby expediting repairs, transfer of loads and personnel, as well as keeping the ship close to the ground where winds are of lower velocity than at levels of the "high" masts. When riding to a high mast the free stern of the mooring airship is practically always going through vertical and horizontal oscillations due to irregularities in wind flow and to temperature changes which temporarily influence the ship's buoyancy. At the American stub mast, the ship, while free to answer horizontal fluctuations, cannot acquire any vertical motion whatsoever and, therefore, the crew of the ship are not continuously flying the ship as is the case when she is moored at a high mast. This stub mast idea has had very successful practical demonstrations at Lakehurst and it is felt that if further results continue to be uniformly successful this type of mooring equipment will not only be developed to a point of increased efficiency, but will at the same time reduce mooring and handling costs materially.

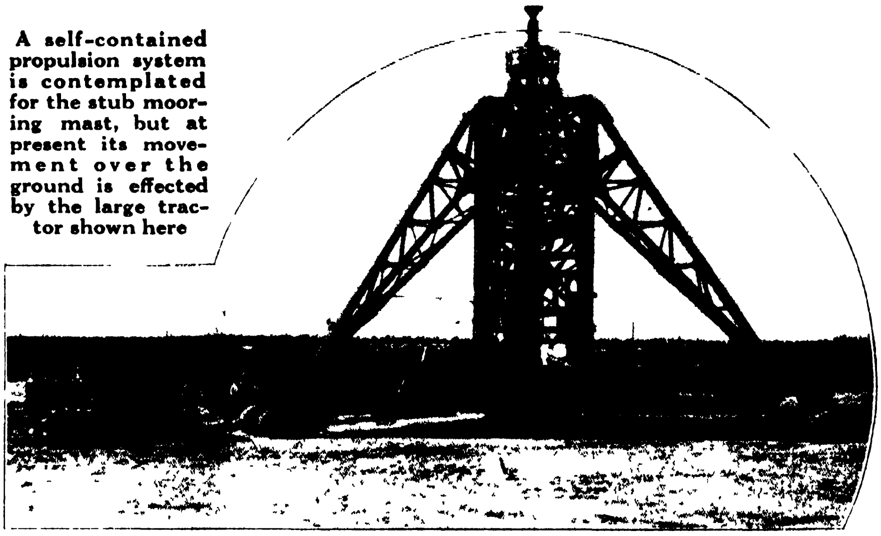
IF after landing from flight, it is desired to house the ship in the shed, the ground servicing connections at the mooring circle are disconnected from the mast and the after portion of the ship is freed from its car. The mooring mast then gets underway with the ship's nose remaining secured just as when moored. Under the stern of the airship, however, there is placed a pneumatic wheel device capable of castering in any direction as well as of furnishing smooth rolling contact with the ground while the mast, with the airship riding to it like a flag, travels from the mooring site to the vicinity of the shed in which the ship is to be docked. A specially devised "tail drag" attached by a line to the ship's stern, follows the ship over the field, but resists any tendency of the stern to lift vertically, by adding its weight to the ship as automatic ballast. Furthermore the mobile mast's own pump and tanks can furnish the ship water ballast if needed as it moves over the ground.

Having reached the docking rails which lie in the prolongation of the hangar direction, the mast comes to rest temporarily. The after part of the ship is secured on each side by an endless wire system which leads from four points on the ship to mechanical trolley systems which operate in the docking rails. These systems are provided with winches to haul the ship up against the wind load in case the wind direction is across the hangar, and enable the airship to be centered between the two docking rails. Held securely in this position, the mast, ship, and trolley systems get underway together and proceed into the shed. In undocking, of course, the reverse system is employed, the mechanical trolley bridle systems holding the ship against a cross wind until clear of the hangar where, by slacking off, the stern of the ship is allowed to swing until it finds its natural position of "nose into the wind." Signal lights similar to traffic lights, and a loudspeaker system mounted on the mast, provide the means for passing orders and information to units and personnel.

Having cleared the hangar, the ship can then either take to the air from that location or be towed to the mooring site or circle and remain there safely until its scheduled time of departure. The limitation on the wind force in which an airship can be docked and undocked by this mechanical means is dependent upon the strength of the airship itself.

IT would not pay nor is it necessary to build an airship structure strong and heavy enough to be capable of withstanding great forces in any direction or at random points. The *Los Angeles*, for example, was not constructed with any idea of mechanical handling devices being applied to it and still we find that the strength of the ship is adequate to allow it to be housed or unhoused in beam winds up to 20 miles per hour velocity. It would be, of course, expensive and complicated to change the structural characteristics of the *Los Angeles* to permit handling in higher winds. When, however, airships are originally constructed with a view to mechanical handling they can, of course, be made adequately strong for handling in greater wind velocities if desired.

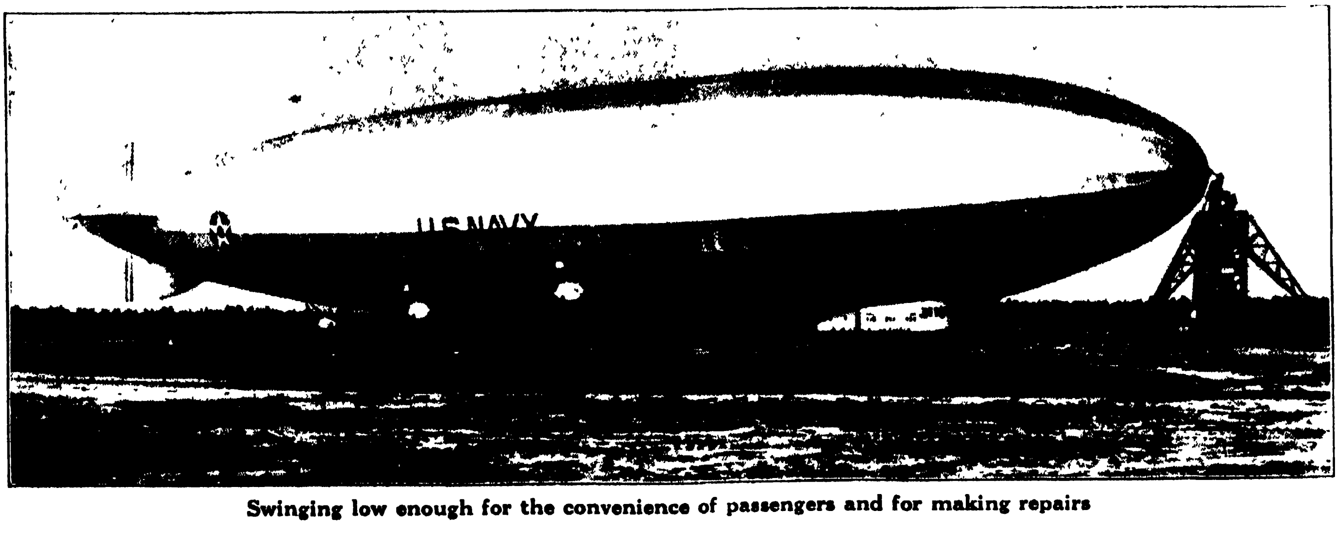
This mechanical handling system is not as yet a fully refined product. It will continue to be modified and perfected, perhaps for years, but fundamentally it has been proved correct. The "iron horse" of the mechanical handling system (as the mobile mast is often referred to) has already during its development period been used in handling the *Los Angeles* on over 30 occasions during the last few months, and by its use the *Los Angeles* has been housed and unhoused in cross-hangar winds of 17 to 20 miles per hour velocity; and it successfully handled the *Graf Zeppelin* while that ship was at Lakehurst last spring. At present its movement over the ground is by a tractor but a self-contained propulsion system for the mast is a contemplated refinement for the near future.



A self-contained propulsion system is contemplated for the stub mooring mast, but at present its movement over the ground is effected by the large tractor shown here

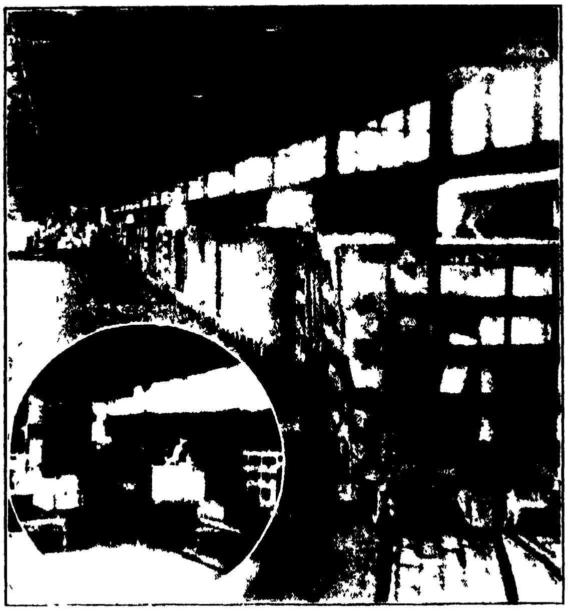
THE stub mooring mast, its mobile features, and other units of the mechanical handling system herein described have been devised, built, and operated by personnel of the United States Navy, principally through the efforts of the Bureau of Aeronautics, the Bureau of Yards and Docks, and the personnel at Lakehurst. No one else in the world has yet attained such solutions except the United States Navy which has been engaged in this arduous task for the past several years. Others, however, are now working on the problem. Recent press reports, for example, indicate that the British Air Ministry is now engaged in the provision of a mechanical handling system for airships, which, according to the announcements, appears to be almost identical with that developed at Lakehurst.

The mechanical handling system is but one of a number of most important airship projects and experiments being conducted by our Navy through the wise provision by Congress of funds for this most important pioneering work. By the continuation of sufficient funds for further experimental work, our Navy will undoubtedly soon contribute other very valuable features to airship operation and thereby expedite the attainment of the high value which the rigid airship potentially possesses not only for naval uses, but for commercial employment as well. With these developments, airship operation can be made practical and economical. We shall have added greatly to the naval usefulness of airships to our fleet. With our natural advantages, such as our helium resources and our great engineering resources, these recent developments should enable the establishment of an aerial merchant marine capable of carrying the American flag to the corners of the earth. In this as in many other pioneering fields, the way will have been pointed out by the Navy.



Swinging low enough for the convenience of passengers and for making repairs

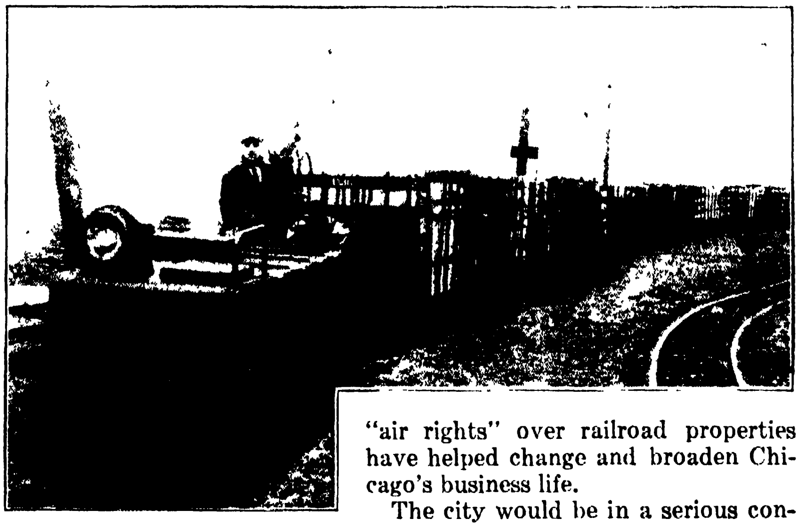
Chicago's Underground Freight System



The cars are loaded and unloaded in the warehouse and reach the tunnel level by means of electric elevators

WHEN Chicago was a bit younger, traction magnates conceived the idea of surrounding down-town Chicago with a belt-line elevated. The idea was probably a good one for the time, but it resulted in constricting and forcing upward hotel structures, department stores, and office buildings. This has resulted in great congestion, particularly in the streets, for until recently it was considered the thing to be in this "loop" and everybody's merchandise had to be brought in and sent out through this section. Now, however, the developments along the Chicago River and the utilization of "air rights" over railroad properties have helped change and broaden Chicago's business life.

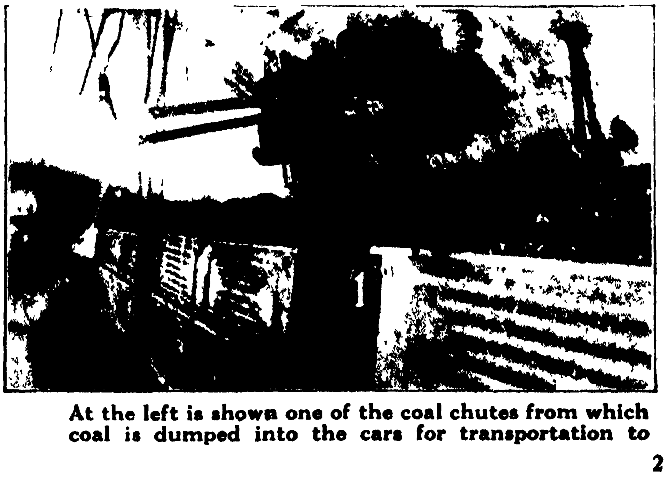
One of the 734 tunnel intersections which make it possible to switch trains to any part of the underground system. The train dispatcher is never out of touch with the motorman

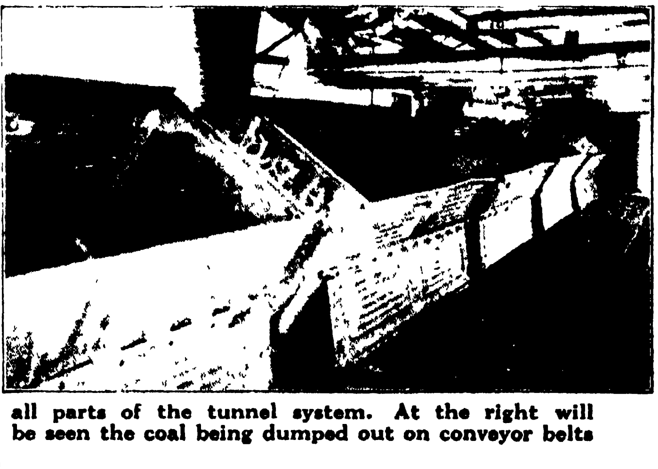


While the tunnel proper is 40 feet underground, much of the freight is picked up at the ground level either at the great railroad freight terminals or the company's own public stations used by 2000 shippers. Note the type of electric locomotive

The city would be in a serious condition indeed if all her commerce had to be street-borne, but fortunately it is not, for 40 feet underground is an industrious mole which never sleeps: it carries freight, package merchandise, and coal, and removes ashes, rubbish, and earth from new buildings.

There are 62 miles of track in the tunnel. Seven hundred and thirty-four intersections make access easy to every street in the loop and as far

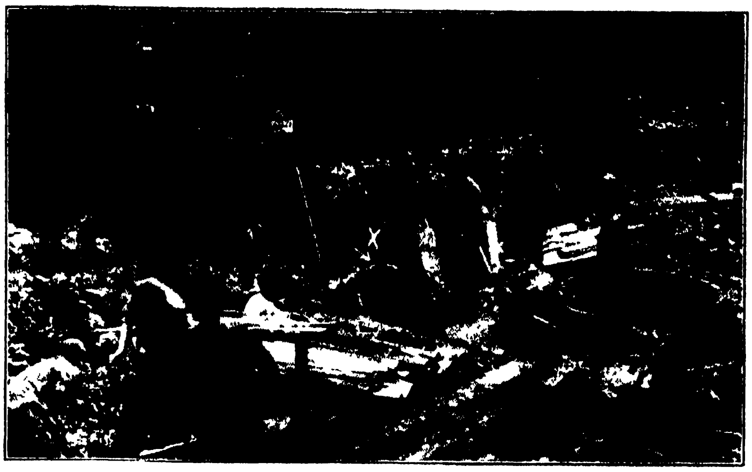




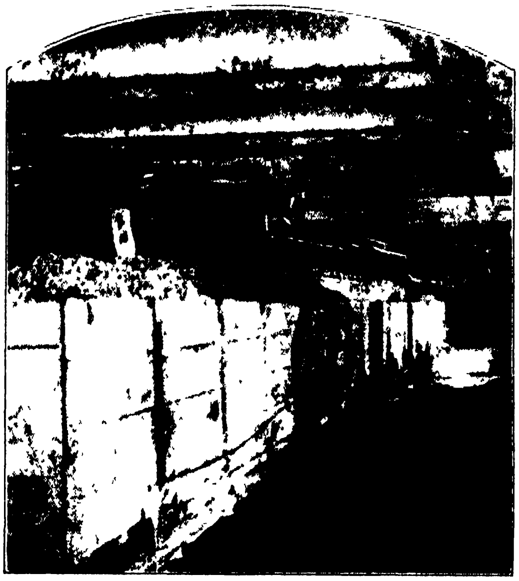
At the left is shown one of the coal chutes from which coal is dumped into the cars for transportation to all parts of the tunnel system. At the right will be seen the coal being dumped out on conveyor belts

distant as even the Field Museum. There are 3304 cars and 150 electric locomotives in use. The merchandise transported yearly amounts to 589,761 carloads, without counting coal, cinders, and excavated material.

Freight is received at public stations, or directly from the railroads or from connected buildings anywhere along the routes. Ninety-six elevators give access to the tunnel level, the cars themselves being raised and lowered on them. As an example, let us consider a world-famed department store. All its coal is delivered, the ashes removed, and much of the merchandise received and shipped without turning a wheel on the streets. What would New York give for a similar system? The movement of package freight between freight terminals is one of the most important functions of the system. The tunnels are also assisting the new World's Fair by taking quantities of excavated material to the lake front. Our illustrations give an excellent idea of the tunnel, its size (gage 24 inches, size of tunnel 6 feet by 7 feet 6 inches) and its uses. We are indebted to Mr. J. H. Burke, Traffic Manager, for a private view of it.

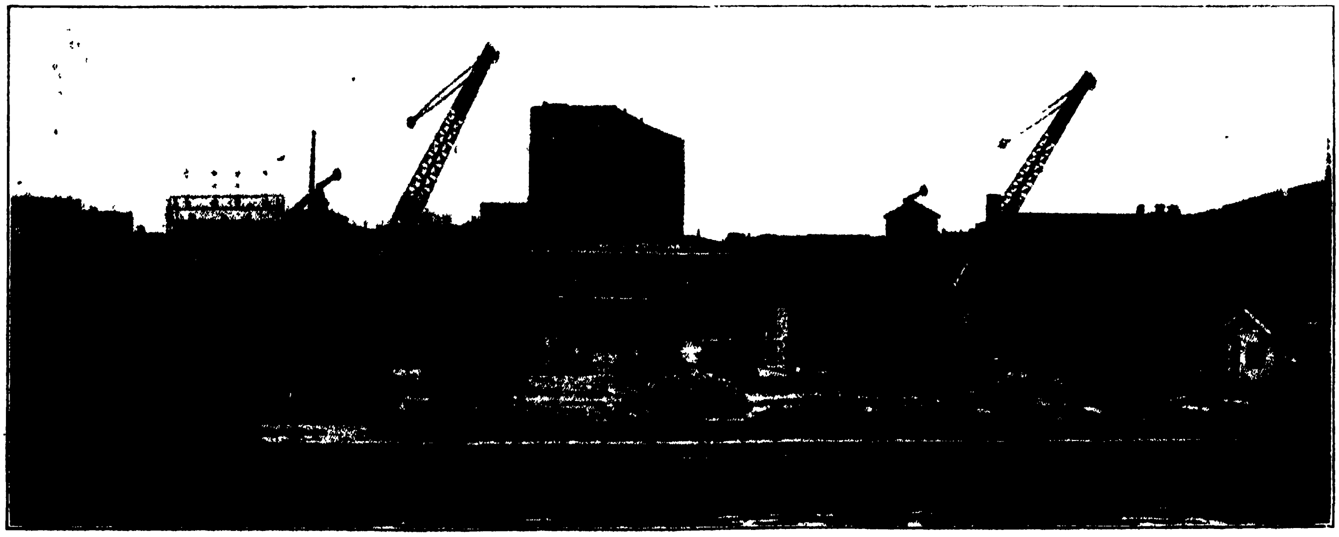


Excavation is easy in rockless Chicago if you are near the tunnels. You bore a hole and shoot the spoil through a chute to the waiting tunnel cars for ultimate disposal



The tunnel takes away the ashes for disposal by dumping them into the lake

Shipping room of a large commercial house showing how freight is loaded on to tunnel cars



Here we have the refuse disposal station where excavated materials, cinders, and other wastes are loaded on barges which are towed far out in the lake for dumping. A total of 102,179 car loads were disposed of in a period of one year

The Scientific American Digest

Conducted by F. D. McHUGH

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Suspended Observation Car

THE Materiel Division of the Army Air Corps has employed a very simple, yet useful idea in connection with dirigibles. An observation car was suspended below an airship by a windlass and cable. By ordinary telephone, communication was successfully maintained with the pilot of the airship. Such a device would be invaluable in fog or in low ceiling work. The airship would hover aloft, while the observer reconnoitered, and then gave instructions for safe landing. Such a car was used by the Germans on their Zeppelin raids, and should be valuable in commercial operation.—*A. K.*

A valuable application of the photoelectric cell. It opens this restaurant door automatically

Door Opens Automatically When Approached

HARD-WORKING hotel waiters, struggling through kitchen doors with heavily laden trays and performing like circus acrobats to make the passage safely, need no longer suffer these agonizing evolutions, for the photoelectric cell has come to the rescue. The General Electric Company recently demonstrated an automatic door-opener by means of which, without conscious human effort, a door can be made to open swiftly and silently—and, what is more, to close in the same manner.

A ray of light focused on a photoelectric cell passes in front of the door. When this ray is interrupted it sets a hydraulic door-opener to work, through the agency of a photoelectric relay. The cell and light are placed several feet from the door and, as a person approaches, his body interrupts the light ray directed at the cell.

The current, hardly great enough to be dignified by the name, is amplified through three large vacuum tubes, the last a power tube. It then sets in motion a small motor which operates the hydraulic device, thus actually opening the door. A lever, comparable to those found on ordinary door checks, forces the door open. A suitable time then elapses before the door closes. When the ray of light is again focused on the tube, the device is again ready for operation. The length of time during which the door is held open can be changed by adjusting the control.

Largest Gas Tank Known

SUPPOSE you had 200,000,000 cubic feet of natural gas that you couldn't use immediately? Where would you keep it? The novel answer to this "poser," evolved by the Canadian government experts, is as simple as it is ingenious. They could think of no container big enough to hold such a quantity of gas except the container from which it came originally, namely, the bowels of the earth. Accordingly, they have determined to pump the gas from a producing field back into the earth in a field previously exhausted. This plan has been approved by the Minister of the Interior, the Gas Conservation Committee, appointed jointly by the Federal and Provincial Governments, and the Premier of Alberta.

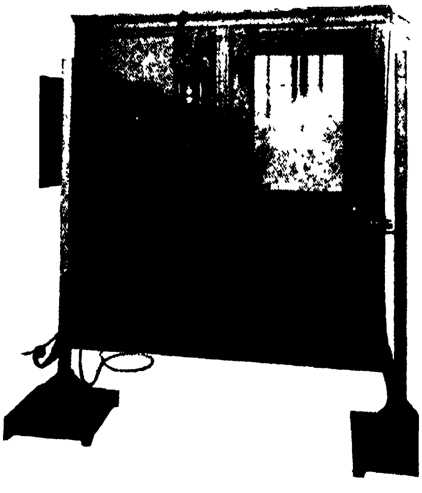
Among the conditions set out in the Order-in-Council under which the reservation has been granted, is the requirement that the company shall commence the actual injection of gas into the depleted sands not later than May 1, 1931, and the amount of gas to be so injected each year shall be not less than 200 million cubic feet until the maximum pressure has been reached and maintained.

The Bow Island gas field, in which the interesting gas storage experiment is to be made, is located about 140 miles southeast of the Turner Valley and a slightly greater distance from Calgary. Prior to becoming depleted it was the principal source of the natural gas supply for the city of Calgary. Now it is proposed to rejuvenate the old wells by bringing gas from Turner Valley, where great quantities are being wasted at the naphtha wells, and to store this gas so that it may be used whenever the peak loads on the company's gas lines may require such reserve supplies.—*A. E. B.*

Ragweed Pollen

THE vast majority of cases of hay-fever occur in people who are sensitive to ragweed. In the fall ragweed pollen is exceedingly prevalent in the air and hay-fever sufferers journey hither and thither attempting to avoid it. Dr. O. C. Durham made a survey of the entire United States during 1929 to locate the boundaries of the ragweed district. He says that the potential ragweed district is the portion of the United States east of the Rocky Mountains, except the south end of the Florida peninsula. In all parts of the area, from one to seven species of ragweed are found.

Thus the actual part of the United States affected seriously by ragweed is little less than three fourths of the total area of the country, but this three fourths contains nine tenths of the population. For each section of the ragweed distric-



Experimental set-up of the photoelectric cell door opener. Light source is at right near knob and cell is directly opposite at left

the almost rigid dates of onset, climate, and termination of the season are being established, and it will soon be quite possible to tell the hay-fever sufferer exactly what day his symptoms are likely to commence in any definite region and almost the day on which they are likely to terminate. It will then be possible for him to move from the district or to take the necessary preventive measures exactly as they are needed.—*M. F.*

Elaborate Ancient Reservoirs

ADEN, on the Arabian peninsula, is a barren spot, for on the mountains and flat sections of this region there is not a spear of green growing things. Near the city of Aden, however, an elaborate series of 12 reservoirs collect what little rain falls and this is used for irrigation. The water quickly becomes foul and cannot be used for drinking purposes.

The reservoirs which empty into one another were partly excavated out of the solid rock many years ago. Of Persian origin, they were discovered in 1884 by a British officer and restored to the condition shown in the accompanying illustration.

Beautifully built ancient masonry reservoirs near the city of Aden

The Hearts of Athletes

FOR years it has been known that intensive athletic effort places a severe strain upon the heart which may result in chronic disability or even in immediate fatality. It is generally thought that the strain produces enlargement of the heart and cases have occurred in which acute dilatation has resulted. Recent investigations made by Dr. T. K. Richards indicate, however, that in the majority of instances after a hard race the heart is small.

When the athlete collapses he seems to be utterly exhausted, gasping for air, and unable to take a full breath. He complains of abdominal pain and lies on his side with his legs doubled up. Although he perspires freely, his body feels cold. In order to determine the condition of the heart, arrangements were made to look at the heart by means of the X ray before and after the race. Members of Harvard's varsity and freshman cross-country squads and individual distance runners of national fame were studied for the purpose. After a race, the hearts were constantly smaller than before the race. Moreover, the hearts of distance runners who had had many years of competition showed the greatest decrease in diameter after racing. As the man's condition improved, the excursions of the heart became greater and sometimes after an hour more the heart seemed to be dilated.

The theory as to these changes that occur is that the contracted heart of athletes is the result of some form of muscle cramp due to excess of lactic acid in the muscle. The cramp can be relieved by inhaling carbon dioxide which sets free the lactic acid. It seems likely that the general collapse is due to the fact that the contracted heart is unable to supply the brain with sufficient blood and that the collapse is therefore due to some form of anemia of the brain.—*M. F.*

The "storage battery" hydro-electric plant described in the accompanying text. During periods of low power demand, the pumps in this plant draw surplus power from the line and pump water uphill into the reservoir to furnish a head sufficient to run the generators during peak load periods

A "Storage Battery" Hydro-Electric Plant

ON the Housatonic River near New Milford, Connecticut, the Rocky River hydro-electric plant of the Connecticut Light and Power Company pumps a river uphill in order to store up a sufficient head of water to run its own generators. It is the first plant in America to pump water for power generation. In general, the pumping is done when there is a surplus of power at other hydro-electric plants in the system. This water supply is used when there is a peak load on the system.

One 30,000-k v a hydro-electric generating unit and two pumps, the latter driven by 8100-horsepower electric motors, have been installed. The head on the units varies from 200 to 230 feet, depending upon the level of the water in the reservoir.

Each of the two pumping units, which were designed and built by the Worthington Pump and Machinery Corporation, has a capacity of 112,500 gallons per minute, or 162,000,000 gallons per day. They are of the vertical-shaft, single-inlet, single-stage, bottom-suction, volute type.

On each pump, the driving motor is mounted directly on top of the casing. These motors are General Electric synchronous motors rated at 7900 k.v.a., 13,200 volts, and run at 327 revolutions per minute.

The indicating gas detector

Indicating Gas Detector

IN various industries there has long been an urgent need for a gas detector which reads directly the amount of gas in an atmosphere being tested. Such a device has been developed in Austria and has been put on the market by the Bureau für Wärmewirtschaft, Laboratorium für Brennstoff-Untersuchungen, of Vienna.

This detector consists of a flexible metal membrane, resembling the case of an aneroid barometer, which is closed by a porous clay plate on one end. When the device is brought into an atmosphere containing diffused gas, the gas penetrates the porous clay and fills the space between the clay and the metal membrane. The pressure therein is increased so that the membrane, which is connected to a pointer on an indicating dial, is distended. As the pointer moves, it indicates on the dial the approximate amount of gas in the air.

Navy Enlists Gas to Build War Ships

GAS has been enlisted by the United States Navy to play a large part in the construction of future vessels, according to reports from the Mare Island Navy Yard.

Although it was used in the past to cut up old battleships, gas played a larger part in building the recently launched U. S. S. *Chicago*.

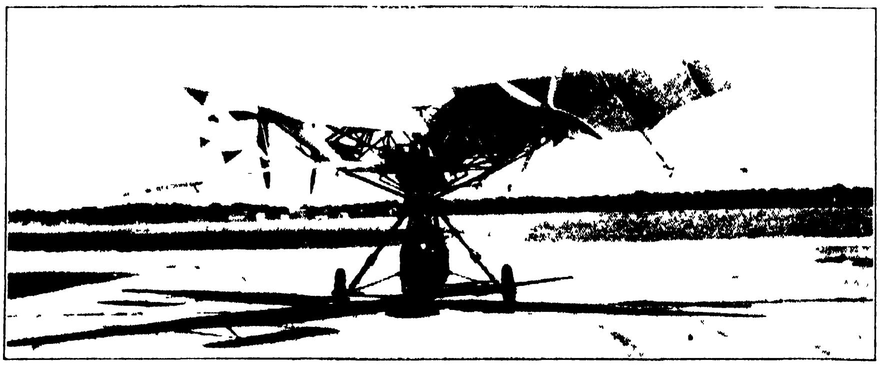
The 1,500,000 rivets required were all heated in specially designed gas ovens because the uniform heat produces stronger rivets and prevents oxidizing, according to the report All the zinc used to galvanize the inner bottom of the cruiser for machinery foundations and for her fresh water tanks was melted in gas-fired vats. Gas was also used to bend all copper pipes installed and for much of the welding.

The Curtiss-Bleecker Helicopter

THERE is no doubt that the helicopter has possibilities of usefulness. It is unlikely ever to compete with the airplane on the score of speed or load carrying, but it might well act as an auxiliary to the airplane, bringing passengers, for example, from the heart of a city to the transport terminal The helicopter also has military possibilities, such as for observation work in very rugged country where the airplane itself would be helpless. Such services by the helicopter have long been admitted as plausible, and great ingenuity and vast sums of money have been spent on the development of various types of direct ascent machines. Unfortunately, the history of the helicopter has been marked by a succession of failures In many cases a reasonable conception has been ruined by insufficient fundamental research. Inventors have been too eager to build and fly their craft.

Now the Curtiss Aeroplane and Motor Corporation has entered the lists with a young engineer, Maitland B. Bleecker, as the inventor and designer of a helicopter. The Curtiss company cannot be reproached with too hasty construction. Systematic research was begun as early as 1927. This has covered aerodynamic work in the wind tunnel, investigations on the cooling of the engine, and so forth. At least we have here a brilliant young engineer, supported by a great company and with all technical aids at his command.

Brief descriptions of the helicopter have appeared in the daily and technical press.



First of the experimental helicopters to give some promise of successful vertical flight in taking off and landing, designed by a young aeronautical engineer

The writer has had an opportunity to examine the novel craft The Curtiss company, however, has been chary of issuing adequate descriptions so far and the following remarks, although carefully considered, must be ragarded as reasonable conjecture for the most part.

The Curtiss-Bleecker helicopter has but a single lifting system, comprising four rotating blades of airfoil section. With a single rotating system, if the engine were rigidly mounted to the fuselage or nacelle, then the fuselage as a whole would turn in space (action and reaction being equal and opposite) to the great discomfort of the pilot. This difficulty has been met by having the engine free to rotate in suitable bearings in the nacelle The engine is mounted somewhat above the nacelle and behind the pilot

The question of transmitting power from the engine to the main rotating blades is a difficult one Nothing would appear simpler than to gear down from the engine to a vertical shaft, which would, in turn, rotate the blades. Unfortunately, a large speed reduction is necessary. The engine must revolve at high speed 2000 revolutions per minute or thereabouts -while the lifting elements should, for maximum lifting power, revolve slowly, say 150 revolutions per minute. The problem of gearing down and transmission without excessive weight, is a formidable one.

Again, the rotating blades must vary their incidence, or pitch, as they move along their circular path. The pitch must be varied rapidly for control or for descent with power off. The design of a good transmission system is complicated by these additional requirements. To avoid these difficulties, Mr. Bleecker has hit o a novel method of attack. He connects the engine through shafting to a number of small propellers, which, in turn, pull the lifting blades around, but leave the lifting elements more or less free from the transmission machinery. The central vertical shaft running from the horizontally placed Pratt and Whitney Wasp air-cooled engine is geared to four horizontal shafts, which again are geared to four, four-bladed propellers of relatively small diameter. The transmission system is external to the main lifting elements which are rotated by the thrust of the small propellers.

Another difficulty in the single-lift-screw-system helicopter is that, in forward motion, the blade advancing into the wind is meeting the air at a greater speed than the blade moving away from the wind. Therefore if the pitch on both sides is the same, the blade advancing into the wind will have a greater lift than the blade retreating from the wind. The result is a powerful rolling moment tending to bank the machine about its main or longitudinal axis. Such a rolling moment would be difficult to resist by the controlling means placed at the pilot's disposal, and even if met by the pilot would leave him dangerously little lateral control.

To meet this situation it is necessary to vary the pitch or angle of incidence of the blades automatically, as they whirl round. Herein lies the function of the auxiliary vanes or "stabovators" as they are termed by the Curtiss company, disposed at some distance behind the main blades. The area of the wings is 322 square feet and the stabovators have an area of 12½ square feet each. The main blades are presumably hinged at such a point along their chord that they tend, under a gravity moment, to increase their angle of incidence. When the stabovater is moving rapidly into the wind, its aerodynamic moment becomes greater in proportion to the gravitational moment. Therefore the stabovator tries to bring the wing down to a smaller incidence or pitch. If the whole delicate situation is correctly adjusted, then the decrease in pitch of the advancing blade balances the effect of the greater speed, and the lift on each side of the airplane is equalized. The dangerous rolling moment disappears. We believe this explanation to be an entirely plausible one; but later disclosures may modify it.

The Curtiss-Bleecker helicopter has a single lifting system comprising four rotating blades of airfoil section. The fuselage is not rigidly attached to the engine; the latter is free to rotate in suitable bearings in the nacelle

The designer of the helicopter has also worked out a system of control about all three axes. The directional control, or rudder, is mounted at the rear of the short nacelle. Contrary to practice with the conventional rudder, the helicopter rudder is hinged about a longitudinal axis. This is evidently so as to provide steering when the helicopter is either climbing vertically or soaring. Under such conditions, the rudder is in the downward slipstream of the main blades. If it were hinged about a vertical axis, nothing would happen. With the rudder hinged about a horizontal axis at its top edge the craft will turn to the right when the lower edge of the rudder is swung right. Our readers will no doubt agree with this supposition after a little reflection. For lateral control and longitudinal control, an ordinary "joy stick" is placed in the nacelle. The joy stick is so connected with the rotating blades that the pitch can be changed either on the right or left side, or ahead or behind the pilot. We imagine that a system somewhat analogous to the floating aileron is employed. Thus a complete control system is provided for.

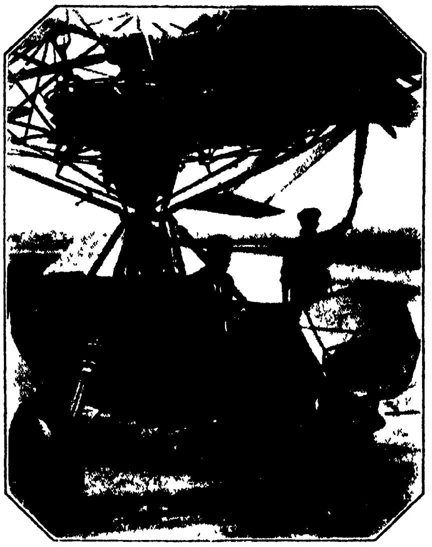
All the main blades can also have their pitch changed simultaneously. This means that they can be given a negative pitch when the engine fails. The blades will then continue to rotate as a wind-mill, providing lift for either vertical descent or descent on a steep path. Ability to change the pitch is also important from the point of view of maximum climb and forward speed. In vertical climb the pitch should probably be somewhat greater than in forward flight. To secure forward flight, the elevator system is employed to tilt the machine slightly down by the nose, so that a part of the lift now acts to give forward pull.

A great deal of thought has gone into the power plant system. Gasoline and oil tanks are mounted so that they rotate with the engine. Electrical connections are taken off the rotating system through the use of a commutator. Through an ingenious system of gearing the pilot has normal throttle control available. A tripper device allows the gasoline feed system to be shut off while the rotor is in motion. To cool the engine, since it is *not* in the slipstream of the conventional propeller, a 32-inch diameter propeller-type fan is placed above the engine, with special baffles to guide the air all around the engine

The landing gear is more or less conventional but the travel of the oleo struts is exceptionally large, to allow for vertical descent with power off. The tail wheel is of the caster type.

The gross weight of the helicopter is 3400 pounds. The useful load is small and some 20 percent of the gross of this useful load - 180 pounds—is in fuel.

The main criticism of the helicopter is complication and the fact that there are so many transformations of energy to be reckoned with. The engine drives shafting. The shafting drives the small propellers. The propellers pull the main blades round. The main blades tilted forward provide the forward pull for the entire craft. Each of these transformations spells a loss. There is no doubt, however, that the Curtiss company will proceed with the utmost caution and will persevere, meeting difficulties as they occur and improving the machine step by step. We wish them every success.—*A. K.*



Cock-pit of the helicopter, showing connection of engine and body

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Exports of Farm Machinery

EXPORTS of agricultural machinery and implements in 1929 amounted to 140,800,000 dollars compared with 116,000,000 dollars in 1928. This increase of 21 percent over the high record established in 1928 is of importance to business, as it relates to one of the great industries that is a large employer of labor and an extensive consumer of raw materials Barring unforeseen calamities to the crops, the outlook seems to be for a continued increase in these products both at home and abroad.

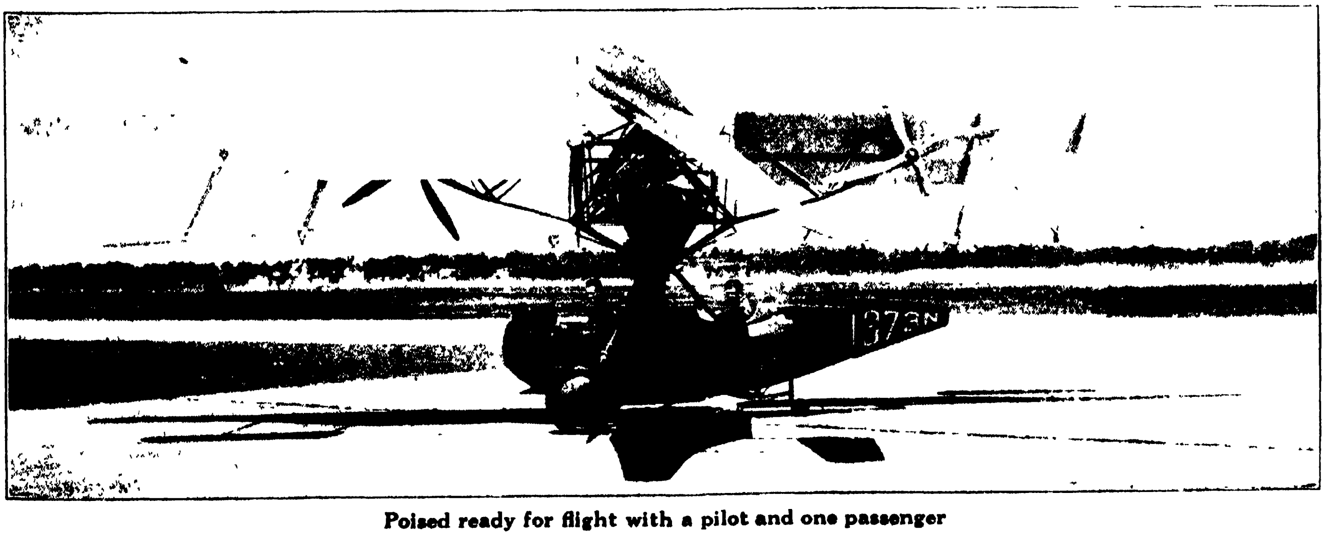
The manufacture of farm machinery and implements in 1928 accounted for 2,200,000 tons of steel, or 6.5 per cent of the total consumption of steel in domestic industry. As the railroads used 16 percent of the country's steel, the farm-machinery business called for 40 percent as much as the railways. This business also called for almost exactly the same tonnage of steel as was exported. Sales of this type of machinery in 1929 were larger than in 1928, due in part to the increase in exports. Thus the export field demonstrates its importance in maintaining one of our great manufacturing industries.

The great increase in power-farming machinery shipped out of the country shows that the trend towards the mechanization of agriculture is not an exclusively American feature. Canada and Argentina, great export wheat-growing countries, and Russia, a "hope to-be" exporter, are the leaders in this kind of machinery. Tractors are one of the features of these exports to the wheat-growing countries. Doubtless our new plan of "farm relief" by reducing acreage and raising less will receive the enthusiastic endorsement of these three countries that stand to profit by taking whatever trade we shut ourselves off from supplying.

Of those countries, Canada, Argentina, and Russia offer great possibilities for power farming. Canada's prairies are especially adapted for it, and the great increase in such heavy machinery taken in the past year shows that the farmers there are appreciating the value of mechanized agriculture. All such methods of production as this decrease the cost and make it possible to sell wheat at lower prices in the world markets. When crops are fairly good, therefore, it stands to reason that this line of manufacture will prosper both at home and abroad. *Barron's.*

Refrigerating Fresh Fruits

FRESH Georgia peaches at Christmastime are the latest triumph in food preservation by freezing Advances in refrigeration practice accompanying the freezing, distribution, and display of frozen food-stuffs were featured at a recent meeting of the American Society of Refrigerating Engineers, held in Atlanta.



Poised ready for flight with a pilot and one passenger

Plans for the production of frozen Georgia peaches on an extensive scale were described by W. R. Tucker. Sliced peaches packed with sugar are to be quick-frozen in one-pound waxed paper containers and then held to supply the "out-of-season" high quality demand.

Extensive experiments covering more than two years preceded the plans for large-scale production. Unsatisfactory for canning because of the very delicacy of cellular structure that is their chief asset from a flavor standpoint, Georgia peaches have presented a difficult over-production problem. Flooding of the market during the brief season in which they reach maturity could be avoided, Mr. Tucker said, by withholding in a frozen condition a sufficiently large part of the crop.

As a result of experiments made last year, the most satisfactory varieties, the proper freezing time, freezing and holding temperatures, and container size have been determined definitely. More than 10,000 pounds of peaches were frozen by Mr Tucker and his associates at the height of the producing season last year, and stored until Christmas time. Then they were packed in solidified carbon dioxide and sent to leading hotels, representative peach growers, home economics bureaus, and other interested individuals. An amazing unanimity of opinion to the effect that these peaches were indistinguishable from freshly picked products resulted from this test With the plans that have been developed, large-scale production will make it possible to market frozen peaches at a price that is considered reasonable for such high-quality products. It is planned eventually to effect national distribution throughout the period when fresh fruit is not available, Mr. Tucker said. —*A. E. B.*

The Trend to Short Waves

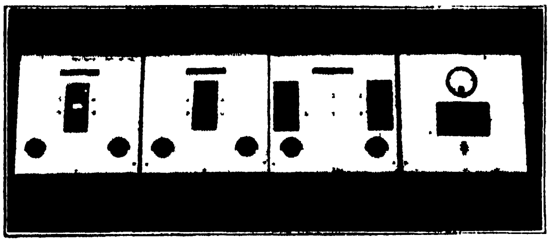
THE growing use of low waves for broadcasting is creating a demand for low-wave receivers, which is being met by several manufacturers, one being C. R. Leutz, Inc., makers of the short-wave Model C receiver illustrated in these columns

The Model C is of unit construction, allowing maximum flexibility, either two, three, or four units may be used together as a complete receiver. The simplest combination is the detector stage and audio unit combined, to which the first and second RF stages can be added. Since each unit is in a separate aluminum cabinet, double shielding is effected, each radio frequency stage, the detector stage, and the three audio stages being in separate compartments. The resultant isolation between the tuned stages is an important factor in the performance of the set.

The tuned circuits in this receiver are designed for maximum and uniform efficiency over the entire frequency range. Ordinary short-wave adapters obtain a wide range by the use of small coils and a large tuning condenser. Vacuum tubes, being voltage operated, require maximum inductance and low capacity, to meet which demands a higher manufacturing cost than is the case with the first-mentioned method of obtaining width of range. But in the Model C short-wave receiver, efficiency displaces cost as the determining factor. Of course, the receiver is unsuited for ordinary broadcast wavelengths, but its efficiency on the short waves is very high. The condensers are of fine construction and of the low loss type, the various tuned circuits are completely shielded; and there has been provided an elaborate system of chokes and by-pass condensers, which confine the radio frequency currents to their proper paths.

One of the problems of short-wave receivers using few tubes is to secure sufficient amplification in the detector circuit to operate properly the powerful audio amplifier To meet the requirements, the Model C receiver has two tuned radio frequency stages. The push-pull audio amplifier has been purposely omitted since the extra input signal required to secure full output cannot always be conveniently obtained in a short-wave circuit. A receiver employing push-pull would operate well enough on strong signals, but the weak ones would be entirely lost The sensitive cascade amplifier guarantees loud speaker volume.

The Model C short-wave receiver is sold without coils, which may be purchased separately to cover any desired bands or wavelength ranges



Panel of the four-unit Model C short wave receiver. Either two, three, or four units may be used as a complete receiver

Interior view of the radio receiver illustrated above

Mineral Oil and Cancer

BECAUSE of the publicity given in recent years to the possibility of producing cancer in human beings by contact with lubricating oils, Dr. Francis Carter Wood of the Columbia University Institute of Cancer Research undertook a study to determine definitely whether or not the ordinary mineral oil used for laxative purposes might have any effect in stimulating the growth of cancer. It is well known that "mule spinners" in the cotton industry, whose clothes are saturated with lubricating oils from the machinery which they use, develop cancers at spots where the skin is irritated by the clothing saturated with oil.

It has also been well established that cancer may be produced in mice by rubbing them with tar. It was found that painting the skin of mice with heavy lubricating oil would produce irritation and overgrowth, but painting the skin of mice of the same type with mineral oil of the kind used for laxative purposes did not produce anything resembling cancer. Feeding of mice with mineral oil did not produce any changes in the intestines or stomach, neither did the feeding of rats with such oil have any cancer-producing effect. It is well known that the skin of the albino mouse is just as sensitive to irritation by oil as is the human skin, and that both albino mice and rats may develop spontaneous cancer of the intestines.

Hence there is no reason to believe that mineral oils, as used in modern life for the treatment of disease, have any cancer producing effect. *M. F.*

Air Trespass Over Private Property

WE pointed out in an editorial in our May issue that the old theory that a property owner's rights extend to the skies has no basis in fact. A federal court, sitting in Cleveland recently, apparently concurred with us in this opinion, but the decision of the court did give to the property owner "possession" of the air up to a height of 500 feet above the land he owns. This is an interesting commentary on the growing need for study of the many legal problems confronting aviation today and, so far as we can learn, is the first really definite legal opinion that a plane may be actually liable for trespass even though it does not touch the ground over which it illegally flies.

Salvaging Everything but the Rattle of Derelict Cars

FOLLOWING the systematic wrecking of more than 18,000 antiquated motor cars, the Ford Motor Company recently announced that the salvaging of materials obtained in this manner is practical and that it is now increasing its facilities for continuing the work on a more extensive scale.

At the present time a force of 120 men at the Rouge plant, Dearborn, dismantles these apparently worthless hulks at the rate of 375 cars every 16 hours. Many parts, such as tires, are salvaged in their entirety and other materials are being converted into useful articles, while the steel is remelted in furnaces to do its bit in the manufacture of Ford cars and Ford trucks.

The derelicts are bought from dealers at a fixed price of 20 dollars a car. There is no restriction as to make, age or condition, except that all cars must have at least some semblance of tires and a battery.

The salvaging of cars that have outlived their usefulness serves three ends. It will rid highways of motor menaces that are dangerous both to life and traffic; it will, to a large extent, free the landscape from unsightly junk piles; and it will convert into usefulness material that would otherwise go to waste.

The present method is, first, to drain the cars of gasoline and oil, both of which are salvaged. Grease is also saved. The cars are then hauled into the building and placed on a progressive conveyor. The headlight lenses and lamp bulbs are recovered. The spark plugs and battery are taken out. All glass is removed. That which is whole or may be cut to useful sizes is utilized for glazing in Ford plant buildings. The broken bits are sent to the Rouge glass factory for remelting. Floor boards travel to the box factory to be used for crate tops.

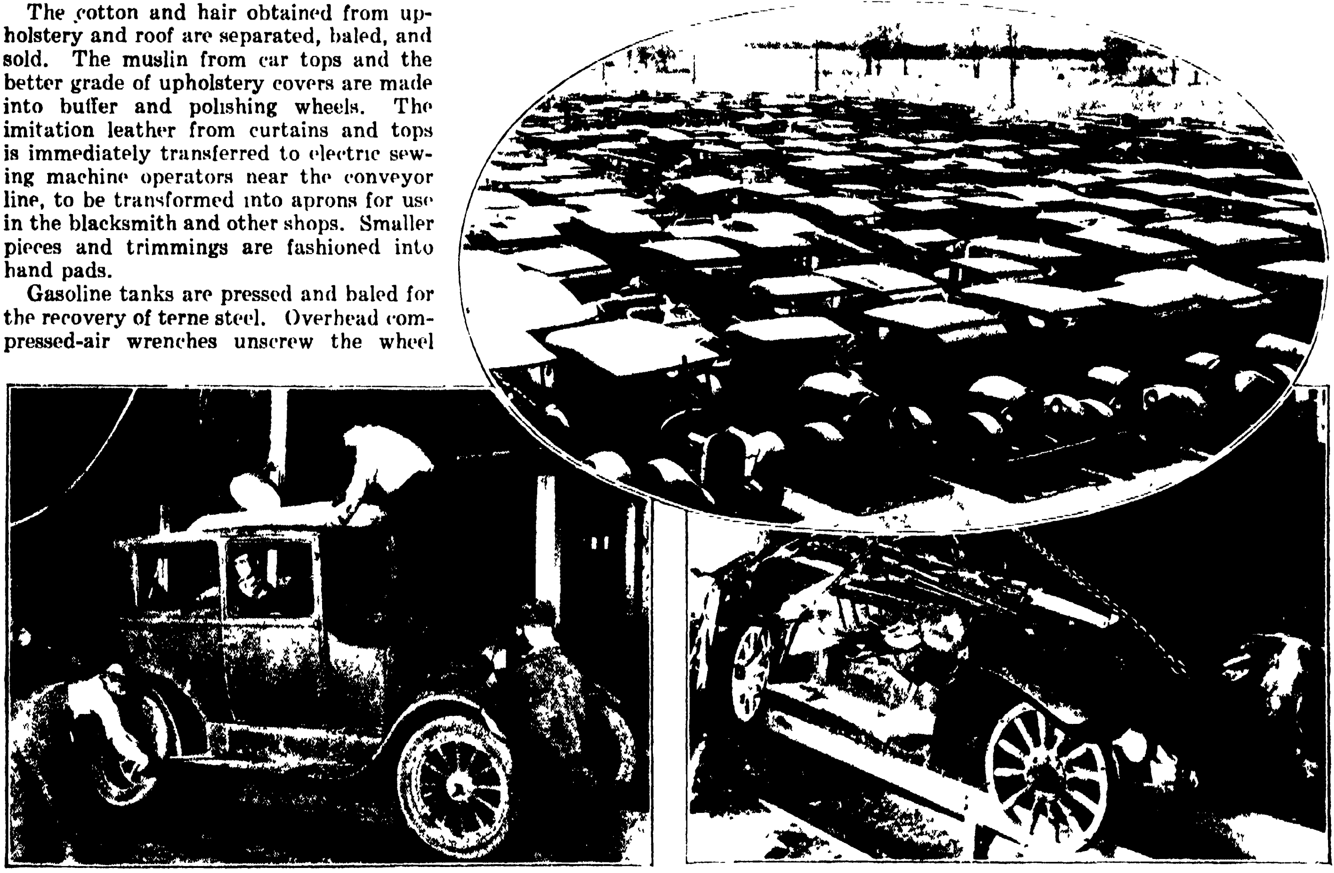
The cotton and hair obtained from upholstery and roof are separated, baled, and sold. The muslin from car tops and the better grade of upholstery covers are made into buffer and polishing wheels. The imitation leather from curtains and tops is immediately transferred to electric sewing machine operators near the conveyor line, to be transformed into aprons for use in the blacksmith and other shops. Smaller pieces and trimmings are fashioned into hand pads.

Gasoline tanks are pressed and baled for the recovery of terne steel. Overhead compressed-air wrenches unscrew the wheel nuts. When the wheels are removed the tires are inspected. If the tread is good they are sold as used tires at the commissary; otherwise the entire unit is placed in automatic shears which sever both tire and rim. The tire is quickly stripped and tossed into a waiting cart to be sold as old rubber. The rims join others for use as furnace scrap.

Horns are salvaged. Likewise hubcaps for aluminum, ignition wire for copper, oil cups for brass, bushings for bronze, and other bearings for babbit. All metals are kept separated by depositing each kind in steel barrels.

As the conveyor-propelled, and now all but dismantled, cars reach a station near the end of the salvage line, men with oxygen torches burn the motors loose from the frames. Overhead compressed-air hoists are attached to the motors and they are swung to a washer. This bath of boiling water and soda ash expels them from the opposite end free from grease and dirt. Meanwhile what is left of the cars continues on the conveyor into a 22-ton press which crushes them. The remains are then transferred to the third conveyor which carries them to the furnace doors.

All Model T engines are conveyed past the washing machine to a group of specially designed presses where they pass through a special process of disassembly.



In the three views above, the oval shows a section of the receiving yard at the Ford plant where old cars are stored awaiting junking; below at left, workmen are stripping the car; at right, car pressed after stripping

553 Hours in the Air

IN the refueling endurance record flight of John and Kenneth Hunter, which ended late in the afternoon of July 4, the engine was put through the most grueling test to which an airplane engine has ever been subjected. The Hunter brothers remained in the air for 553 hours, 41½ minutes.

The engine used was a Wright Whirlwind 300, which, before the beginning of the flight, had already had 300 hours service. During the endurance flight, the plane flew approximately 40,000 miles, non-stop, around and around in the vicinity of the airport. This figure, however, is small in comparison to some of the performance statistics of the flight. The revolutions made by the crankshaft were 52,000,000; each valve opened and closed 26,000,000 times; strokes made by each piston were 104,000,000; each piston traveled 9025 miles; and the revolutions made by the supercharger amounted to 405,600,000!

Brain Changes After Gas Poisoning

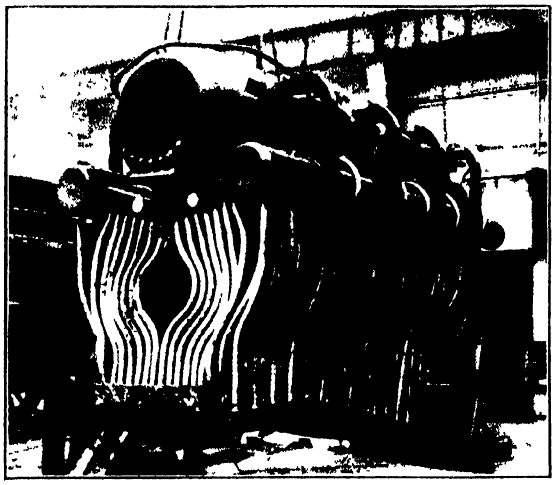
POISONING by illuminating gas containing carbon monoxide is one of the most common conditions in modern life. So wide are the uses of gases that the hazard is almost constant. Only the high development of modern plumbing keeps the gases within reasonable limits. Moreover, there is also a hazard from carbon monoxide due to the amount of the gas contained in the exhausts from automobiles. Many cases occur every year due to running the car in a closed garage.

The immediate symptoms after gas poisoning are unconsciousness, if a sufficient amount of the gas has combined with the red coloring matter of the blood death promptly ensues. If the patient recovers, nausea, vomiting, headache, and weakness are not infrequently seen. After the patient recovers, even from severe cases, he may develop secondary conditions, including pneumonia, gangrene, and particularly changes in the nervous system. The nervous system of the human being is such a delicate structure and so highly developed that it is particularly sensitive to poisonous influences.

In a case described by R. P. MacKay, a locomotive fireman 29 years of age who was found unconscious in his garage due to inhaling exhaust gas from his car, developed serious disturbances of the nervous system and symptoms like those of shaking palsy, his speech became monotonous, and his hands and head were subject to tremor.

Mental decline and exhaustion followed as well as symptoms affecting the body generally and the skin. After many months the patient began gradually to improve, but apparently the recovery was not complete.

Thus the danger of such poisoning is not only the immediate danger to life, but the danger of producing such serious changes that invalidism remains permanently. Apparently the deprivation of oxygen causes changes in the nervous system which the body does not readily overcome.—*M. F.*



Boiler of the locomotive recently built in England for experimental operation at a high pressure of over 900 pounds per square inch. The manner in which high-pressure steam is generated in the vertical tubes and the steam drum above them is fully explained in these columns

Beard 1200 Years Old in Ancient German Grave

A 1200-year-old beard is the unusual find made in an ancient grave accidentally uncovered by ditch-diggers near the town of Lorrach in Baden, Germany. The workers came upon several burials, one of which was protected in a coffin made of rough sandstone slabs. This latter, when opened by Dr. Georg Kraft, of the University of Freiburg in Breisgau, disclosed the somewhat decomposed skeleton of a man about 40 years old, with a matted triangle of wavy, red-brown hair where the chin had once been. The beard has a curious shape, being pointed but longer on one side than on the other.—*Science Service.*

Experimental High-Pressure Locomotive

DURING the latter part of December, 1929, a new high-pressure locomotive was introduced on the London, Midland and Scottish Railway. It was built by the North British Locomotive Company, Ltd., Glasgow, in conjunction with The Superheater Company, Ltd., under the supervision of Sir Henry Fowler, K.B.E., Chief Mechanical Engineer of the London, Midland and Scottish Railway.

The frames are standard with those of the three-cylinder simple 4-6-0 type locomotives of the "Royal Scot" class. But the higher initial working pressure and the increased range of steam expansion possible with this new engine led to the adoption of the three-cylinder compound arrangement.

The high-pressure cylinder is located well forward between the frames, and drives the front pair of driving wheels by means of a cranked axle. The two low-pressure cylinders are located outside of the frames and are connected to the intermediate driving wheels. Both the high- and low-pressure cylinders are set at an inclination of 1 in 50 with the horizontal.

The boiler of this locomotive is the most noteworthy feature, the design for which The Superheater Company, Ltd., is primarily responsible. The boiler consists of three portions generating steam at 1400 to 1800 pounds, 900 pounds, and 250 pounds per square inch, respectively.

The 1400- to 1800-pound section forms the watertube firebox and is a closed circuit. The vertical tubes are connected at their lower end to the foundation ring and to the ring forming the base of the combustion chamber. At the upper end they are expanded into two cylindrical equalizing drums from which coils pass to the interior of the large steam drum. The steam circulating in these coils evaporates the water in the large steam drum and generates steam at a pressure of 900 pounds per square inch. This large drum is a machined forging of nickel steel. The steam generated in this drum is passed through the superheater to the high-pressure cylinder.

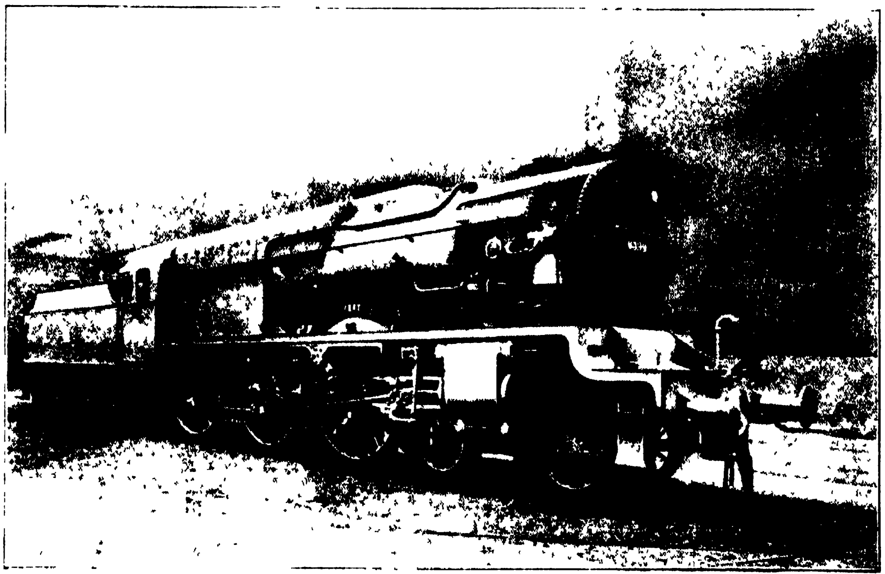
The forward portion of the boiler is similar to the standard locomotive boiler, the shell is of nickel steel and the tube sheets of mild steel. Steam is generated here at 250 pounds per square inch.

Water is fed to the high-pressure drum by a pump drawing its supply from the low-pressure boiler. Water is supplied to the low-pressure boiler by a live steam injector on one side and an exhaust steam injector on the other. Arrangements have been made to by-pass any excess pressure from the high-pressure drum to the low-pressure boiler to avoid waste through blowing off.

The throttle lever operates the high and low-pressure throttles simultaneously.

Steam from the high-pressure drum after being superheated passes to the high-pressure cylinder and is exhausted into a mixing chamber where it meets the low-pressure steam which has been superheated. The mixture of the two passes to the two outside low-pressure cylinders.

This locomotive weighs 174,200 pounds or, with tender, 261,600 pounds; and has a tractive effort of 33,200 pounds. It has been introduced experimentally to be used on the heaviest main-line express trains on the London, Midland and Scottish Railway.



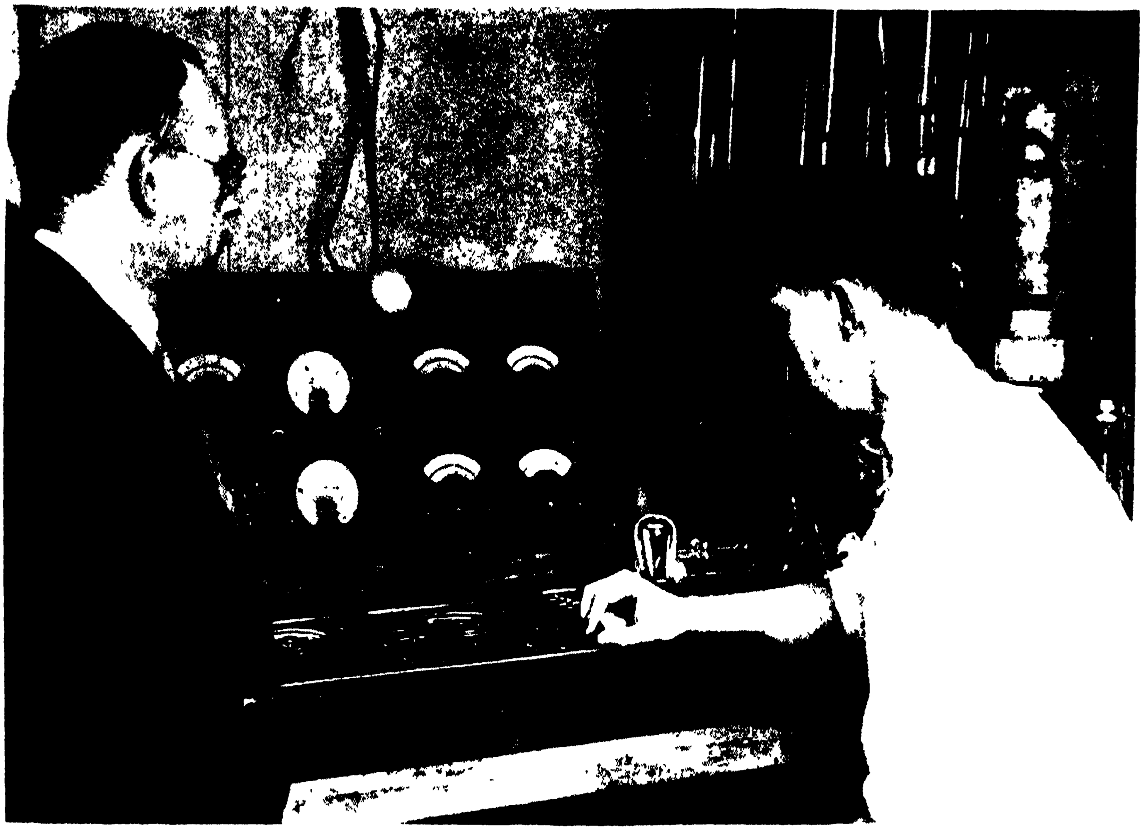
Photograph courtesy The Superheater Company

The London, Midland, and Scottish Railway's high-pressure locomotive

Chemical "Rain-Maker" Helps Modern Highways

IN this enlightened age, the professional rain-maker finds few customers gullible enough to believe that cabalistic incantations can precipitate a shower; yet chemical engineering has developed a thoroughly practical method of enticing moisture from the atmosphere. True, the method is not adequate for the farmer's horticultural needs, but it is extremely efficient for settling dust on dirt and gravel roads, and thus a boon to motorists and residents along the highway.

Calcium chloride is the substance which coaxes moisture from the air, even on the brightest days of summer. This snowy white chemical has the property that chemists call "deliquescence," which simply means that it has a strong chemical affinity for water and will attract it from the surrounding air, even when the latter is comparatively "dry." This property has long been known but it is only recently that chemical engineering has made calcium chloride available in the inexpensive, convenient form suitable for spreading on dusty roads. It is said that two applications during the dry summer months will settle the dust as effectively as would a light shower every day.



"SUBSTITUTE NICKEL *for* PLATINUM!

we can do Better *than that...*"

When the radio industry was young and only a few thousand technically minded enthusiasts were hooking up receiving sets, radio tubes were a laboratory product. The use of costly platinum-iridium for their filaments was not a handicap. For comparatively few tubes were in demand.

Westinghouse engineers, however, foresaw a serious situation. When millions of radio sets came into use there would not be enough platinum available to make the tubes they would need. A substitute material just as satisfactory must be found. Westinghouse laboratories set out to find it.

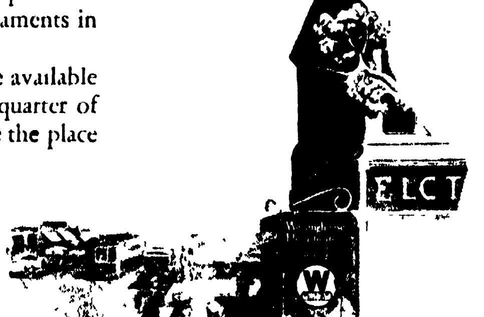
Soon a young engineer reported that nickel would meet the requirements. From a practical standpoint it made as good filaments as platinum. It would do. But Westinghouse engineers said: If a pure metal is as good as platinum, it should be possible to produce an alloy that will be far superior.

Months of tireless research and experimenting followed—development work that called into play the broadest scientific knowledge. Eventually the ideal combination of metals was produced, Konel metal, stronger than any alloy steel, and far superior to platinum as a core for oxide-coated filaments in radio receiving tubes.

If sufficient platinum were available it would take more than a quarter of million dollars worth to take the place of the Konel metal used in vacuum tubes each month. And vacuum tubes are only one of its possible applications. Konel metal meets severe service requirements such as those confronted in gas engine valves and spark plugs. Its commercial possibilities have only been touched.

Tune in the Westinghouse Salute over WJZ and the coast-to-coast network, every Tuesday evening.

Westinghouse



Calcium chloride in its new "flake" form, is also finding growing application in the construction of concrete highways. It may be coated on the surface of the finished paving or added to the concrete mix. In the former case, the calcium chloride cures the concrete by supplying moisture—from the air—for the surface of the new road, thus preventing premature drying of the base as well as the surface. When the chemical is added to the concrete mix – two pounds, in solution, for every 100 pounds of cement it eliminates all other forms of curing, such as straw covering, and gives a pavement that may be opened to traffic in one half the time required by the old methods. *A. E. B.*

The Germ in the Blood

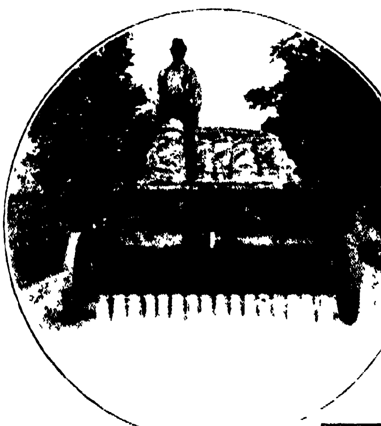
ORDINARILY the blood is free from germs. One may take specimens of blood and put them in a bacterial medium again and again and fail to grow a single germ from the specimen. In times of serious infection, however, germs get into the blood. Since the germs vary in their virulence and in their character it is, of course, desirable to know as soon as possible the type and the numbers of the germ involved. In order to settle this fact, various bacteriologic techniques have been developed, one of the most interesting having been devised recently by Dr Reuben Ottenberg, who has developed the system called "differential blood cultures."

In system, blood is taken directly from the internal jugular vein, or from the arm vein, or perhaps from a vein directly draining the spot at which the germs are supposed to be developing. Another specimen is taken from a vein at a distant point and the number of germs in the blood taken from two or three places is compared on blood culture plates. If, for example, there is a severe infection of the mastoid or of the blood vessels on either side of the skull, the blood taken from the jugular vein on that side will contain many more germs than the blood taken from the arm vein or the leg vein in the same patient.

As is shown in the illustrations, the method works out satisfactorily and is of great value in making the diagnosis and in determining the procedure to be followed. Doctor Ottenberg applied the method in 29 cases with satisfactory results. Of course, the failure to find the germ in any of the cultures does not absolutely indicate its absence but may indicate the necessity for making a further study one or two days later.—*M. F.*

Launching and Picking-up Seaplanes

SO far, in using a seaplane in conjunction with a steamship, attention has been concentrated on specially prepared runways or on catapults. For picking up a seaplane from the water, cranes have been employed. *The Aeroplane* (London) points out that long runways are difficult to install, catapults are expensive, and fast steamers are not supposed to stop in the middle of a run.



Calcium chloride, a snowy white chemical, coaxes moisture out of the atmosphere when it is spread on dirt roads. This deliquescence keeps the dust down because of the wetness. The chemical is also mixed with concrete to eliminate the costly process of watering the laid concrete or covering it with straw. Above is shown a calcium chloride spreader in action and at right a concrete mixer where the chemical is used

Therefore an entirely new method of launching and picking up seaplanes, invented by a German engineer named Kiwull, is of decided interest.

The Kiwull "Watersail," as it is called, consists of a spread of canvas about 98 feet long and 33 feet wide, with spreader booms on the under side One end of this canvas runway is attached to the deck over the stern of the steamship and the other end terminates in a kind of drogue made of wide-mesh netting. This end is attached to the ship by two ropes. The action of the drogue is to cause the water to roll in over the end. This makes it easy for the seaplane to taxi behind the steamer and run onto the trailing runway. When the seaplane is once on the runway, the floats are attached to skids and the whole machine is hauled up the inclined canvas slope. The process may be be reversed for launching.—*A. K.*

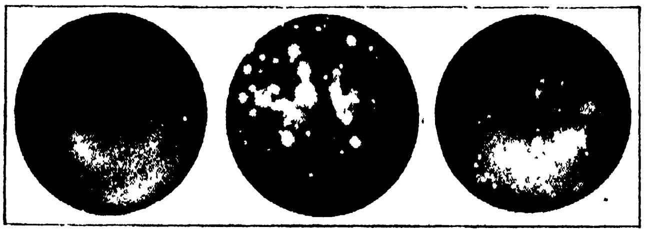
Hen Changes to Rooster, Then Changes Back Again

A HEN that became a rooster and then exercised the prerogative of her former sex and changed her mind, becoming a hen again, is the freak fowl described in the *Journal of Heredity* by Drs. R. A. McCance and A. Walton of the pathological department, King's College Hospital, London.

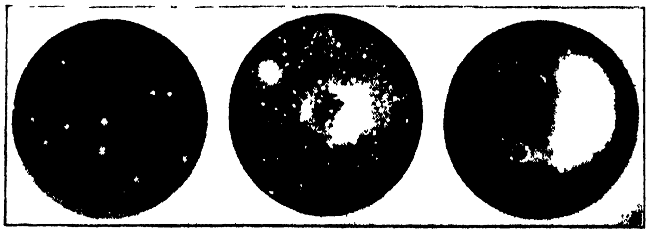
The bird, a light Sussex pullet, was hatched with seven other pullets in March, 1925. In October of the same year all eight commenced to lay and continued to do so until the spring of 1926. All then moulted and while the normal birds soon put on their new plumage, this freak remained practically nude all summer and autumn.

Early in 1927 she slowly assumed male plumage and grew spurs, but no comb. She also put on additional height, becoming two inches taller than her sisters.

She (or "he") commenced to rule the farmyard. She called the other hens to food, escorted them to the nest boxes, shepherded them about the yard, and in general conducted herself like the "cock



Blood plates of a case of thrombosis of the left lateral sinus, showing: left, blood culture from left jugular; middle, from the right jugular; and right, from arm



Plates from a case of thrombosis of right lateral sinus, showing: left, culture from right jugular; middle, from left jugular; right, from arm—white spots are bubbles

of the walk." And she laid no eggs at all. In the autumn of 1927 she failed to moult with the others.

During the following spring she was seen going to the nests and clucking. A dozen eggs were placed under her as an experiment. Still wearing her male feathers, she faithfully sat on them, hatching out 11 chicks and proving an excellent mother afterwards.

Subsequently, still in male disguise, she began to lay eggs again. That autumn she moulted, resuming female feathers, but keeping her spurs. Throughout the winter of 1928 and spring of 1929 she laid regularly, mostly doubled-yolked eggs.

Usually when a hen reverses her sex, an examination of her internal organs will disclose some diseased condition, most probably in her ovaries. But when this hen-rooster-hen was killed and all of her glands subjected to minute examinations, nothing whatever could be found wrong with them. She remains an unsolved physiological riddle.

The editor of the *Journal of Heredity* adds a note telling of a somewhat similar case recorded a couple of years ago in this country. A hen assumed male feathers, but continued to lay. While she was still disguised as a rooster she was mated to a real White Leghorn male bird, and produced fertile eggs. She did not, however, raise her own family. Subsequently she moulted and her new feathers were those proper to her female sex *Science Service.*

Calcium Alloys Find New Uses

NEW commercial calcium alloys have been studied by Prof. J. Meyer, of Breslau, Germany, and are finding various uses. They are rather sensitive to air and moisture, forming a dense white smoke when burned. For some purposes the activation of calcium by sodium is of significance.

Chemical and Metallurgical Engineering reports that experiments by A. von Antropoff at Bonn have proved that minute quantities of metallic sodium at the surface of calcium can incite its reaction with nitrogen. Calcium filings can be activated by precipitated sodium fumes. The same investigators likewise report on the reaction of calcium and nitrogen in the presence of the rare gases, by which argon, for example, can be quickly and completely freed of nitrogen. The use of this process for the extraction of helium from natural gas seems to offer interesting possibilities.

Measuring Height in Seaplane Landings

A CABLE from London to the *New York Times* reads as follows:

"Experiments carried out at Calshot make night flying possible for seaplanes by means of small searchlights fitted beneath each wing. The rays converge at a predetermined distance from the plane, forming a large patch of light on the water and revealing exactly how far the pilot is above the surface when he is coming down."

It is quite difficult to estimate the height above water even in the day time, because definite points of reference are lacking. At night this is well nigh impossible. The cable needs a little interpretation, however.

If the small searchlights are placed under

Miles and Miles of Yellow Strand

This is the age of big projects—the deepening of waterways, the digging of great canals for transportation and drainage, the erection of mammoth dams to impound water for irrigation and power.

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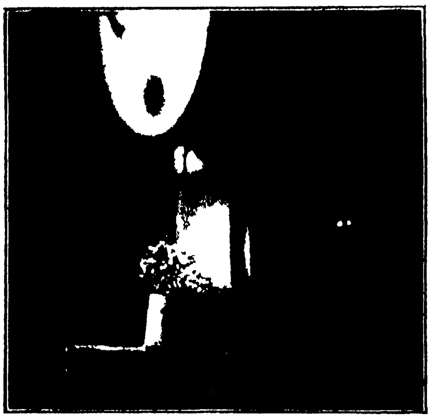
each wing tip, at the proper angle to one another, their lights will indeed converge at a certain fixed distance from the wing. If the distance between the searchlights and the angle between them are both known, this distance is readily calculated. Now suppose that, by means of an inclinometer, we can tell the inclination of the plane to the horizontal. Then we can calculate its distance above the water. The naviagtor in these experiments probably sights the patch of light, reads the inclinometer, and picks off the height from a large and clearly visible chart mounted on the dashboard in front of him.



How minerals glow when subjected to the influence of cathode rays

The device is only in its experimental stage, but is evidently correct in principle, and may be very helpful in the night flying of seaplanes.

Cathode Rays Detect Synthetic Jewels

SYNTHETIC sapphires can be detected readily from the natural stones by means of the cathode-ray tube. The use of the tube in this work is the first commercial application of the apparatus which was developed in the research laboratory of the General Electric Company by Dr. W. D. Coolidge about four years ago.

Sapphires, next to diamonds in hardness, are used by the company at the rate of more than a million and a half a year as jewels for bearings in meters and other delicate electrical instruments.

Trays of sapphires, both natural and synthetic, are exposed in a dark room to the powerful rays of the tube for a few seconds. All glow or radiate colors while exposed to the rays, but when the rays are turned off, the natural stones cease to glow whereas the synthetic stones continue to glow

In addition to sorting the natural from the synthetic sapphires, the rays also help determine where both the natural or factory-made gems come from, an important advantage according to engineers.

"Should sapphires from Montana be mixed with stones from Australia, we could find this out with the cathode rays," B. W. St. Clair, of the company's standardizing laboratory at Lynn, Mass , explained. "In the case of synthetic stones, in most cases we can determine which factory made them by the different hue of the glow while the rays are on.

"We have one particular kind of natural sapphire which does not glow at all. In this case, the lack of glow under the rays immediately tells us its origin."

Tests have been made with diamonds and it has been found that synthetic stones turn decidedly brown when placed in the rays, whereas there is no change in natural stones. However, these tests have been but meager and no definite conclusions have been reached.

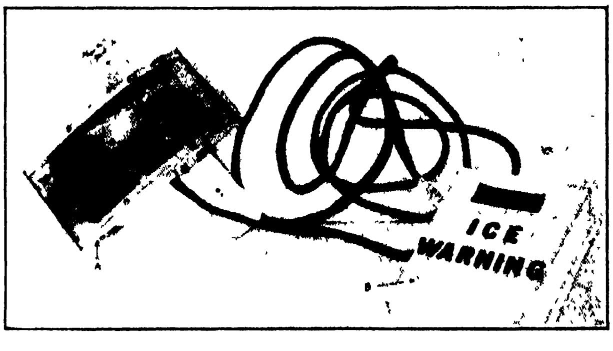
An Ice-Warning Thermometer

IN our July 1930 issue we described the very interesting experiments of Dr. Geer of Ithaca, whereby rubber, oil-impregnated airplane "overshoes" seem to have met the danger of ice formation. It still remains to be seen whether practical aviators will resort to these overshoes. Airmen have a horror of gadgets, and operators may fear that the added cost and a possible decrease in aerodynamic efficiency will be prohibitive. In the meantime it is the concensus that it is a very sound plan to warn the pilot that he is flying in a danger zone, namely where temperatures are between -4 degrees and 0 degrees, centigrade, and when he had better proceed to a zone of higher or lower temperature. A special instrument designed to warn the pilot of this danger zone is described by H. B. Hendrickson in *Instruments*. It is shown in the photograph. Essentially it is a temperature-actuated switch which controls a red light on the instrument board of the airplane.

Rough sapphires, synthetic and natural, are sorted by cathode rays

The thermal switch A is placed on the strut or other exposed part of the airplane, while the indicator box B is installed in a convenient place in the cockpit. The light behind the window in the indicator appears only at the above mentioned temperature range, -4 degrees to 0 degrees. For ease in installation on the ship, the instrument is made up in a unit with its own battery, using pocket flashlight cells of standard size, located in the box B.

The unit A in the illustration at the right is the thermal switch of the ice-warning thermometer. The box B is the indicator, and contains the battery



A bi-metal coil moves the switch, as the temperature decreases or increases and expands or contracts the coil. The contact points are made of coin silver. The lower contact is made crescent-shaped so that the switch arm can easily ride over it without jamming. When the temperature is in the danger zone, the switch assumes such a position that the circuit is closed and the battery lights the lamp.

Although the bimetal coil and contact points are enclosed to provide protection against the weather, tests show that the lag is not appreciable. Severe vibration does not interfere with the instrument.—*A. K.*

Mechanical Exercisers

DURING the past year there has been a great vogue for vibration and shaking of various portions of the body by the use of machines especially built for the purpose. These machines have been sold with claims that they would reduce weight, increase health, and in many ways take the place of exercise. Actually the machines are simply devices for producing passive motion in some part of the body. Moreover, cases have occurred in which the machines have been used by people with ulcers of the stomach and intestines or with swollen gall bladders, and the results of the agitation have been to burst the ulcer or to increase the inflammation and thereby to cause serious illness if not death of the patient.

The Council on Physical Therapy of the American Medical Association has recently issued a report governing the use of these devices. The Council argues that the point of view which their use develops in the patient is wrong. The advertisements and the instructions for their use often convey the impression that the machine will do the work necessary to cure the patient and that the patient does not have to work. Volitional effort is not encouraged, and the machine often is regarded as the only factor in the cure. The more expensive the apparatus or installation, the more this thought will be developed. These machines do not develop volitional effort of any kind—the work being done for and not by the patient. This develops a poor mental attitude in a patient and will react to his detriment.

These machines do nothing that can not be accomplished equally well by simpler apparatus or none at all. For example, many of these machines are sold to reduce excessive abdominal adipose tissue. In these cases the same results could be accomplished by leg and abdominal exercises without apparatus, with the patient giving himself heavy kneading massage at the same time that he is taking his exercises. In most cases, for general weight reduction, much better results could be attained by a walk or a slow run in the fresh air.

These machines treat only one part of the body at a time and do not have the advantages of general exercise in developing other parts of the body. Vibratory massage of the abdomen with a strap attached to a motor for 10 minutes can not give as much benefit as does a 10-minute fast walk with conscious effort given to pulling in the stomach. The benefit of deep breathing, exercise of many muscles, and increase of circulation is actually obtained under the latter conditions.

The use of apparatus is stereotyped and monotonous. The physician prescribing one of these machines is making the same mistake that he would by prescribing only one form of massage or exercise. The patient will soon tire of its use. This form of massage vibration and shaking has little place in treatment, and better results could be secured by definite exercises varied enough to prevent monotony or by occupational therapy to prevent loss of interest.

The physiologic effect of mechanical exercisers is the same as of that form of massage which gives vibration and shaking. The effect of this form of massage has not the same effect as active exercises and can not have the same benefits.

The mechanical exercisers are often actually dangerous. The Council on Physical Therapy has records of severe injuries caused by these machines—ruptured appendix, hernias, ruptured bladder, ruptured duodenal ulcer, pleurisy with effusion, and torn penis.

The Council on Physical Therapy of the American Medical Association therefore condemns the sale of these mechanical exercisers to the public for the following reasons:

1. Volitional effort is not encouraged.
2. The same results could be accomplished without an apparatus.
3. Treating only one part does not give any of the advantages of general exercise.
4. The use of such apparatus is monotonous and the patient loses interest in treatment.
5. The effect is that of massage and lacks the physiologic benefits of exercise.
6. Such apparatus is definitely dangerous. -*M. F.*

Could Pave Broadway With Silver—But Won't

THE world production of silver for the entire period from 1493 to 1927, inclusive, has been over 14,000,000,000 ounces, or about 14 times the weight of gold produced in the same period, according to the United States Bureau of Mines, which has conducted an economic survey of the subject. This amount of silver would make a cube measuring 114½ feet on an edge, or it would pave Broadway, New York, six inches deep, from the Battery to Central Park, a distance of over four miles. Since 1888, more silver has been produced in the world than in the period 1493 to 1887; in other words the production of 396 years has been exceeded by the production of the last 39 years.

In spite of the greater relative increase in the production of gold than that of silver, the price of silver has declined. This decline in the price of silver has been a result of a lessening demand rather than an ab-

(*Please turn to page* 226)

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The Amateur Astronomer

Conducted by ALBERT G. INGALLS

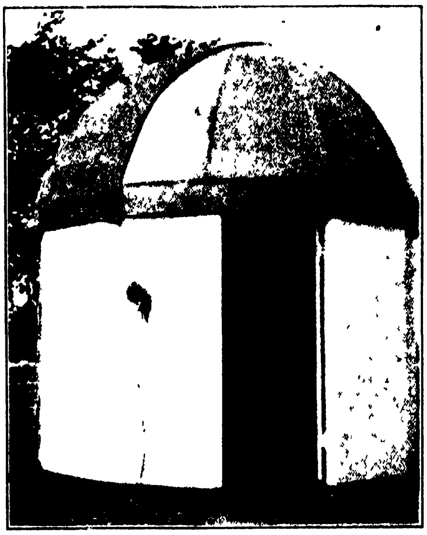
NOW that cooler days to work in are in sight, it may be about the psychological time to think of building a private observatory to house the telescope for more comfortable use in the cold months. It seems odd that more amateur telescope makers have not thus equipped themselves.

Pickering's housetop observatory

One of the best observatories is the simple straight-sided box type, equipped either with a slide-off roof or a traveling gantry roof as shown on the opposite page. However, there is this to be said. None of these straight-line "chicken-coop" types of structure look much like an astronomical observatory. The amateur may perhaps be pardoned if he prefers his neighbors and townspeople to know that the structure he creates houses a telescope.

To build the hemispherical type of dome requires no particular skill, though admittedly it involves considerable fussing and fitting. Designs vary widely. Usually the dome proper consists of a horizontal wooden ring and a number of upright curved ribs, covered with some kind of roofing and provided with a slot opening for the telescope. The whole dome is mounted on rollers and turns on the plate of the fixed building.

Yalden's design, turned cornerwise



One of Schroeder's designs

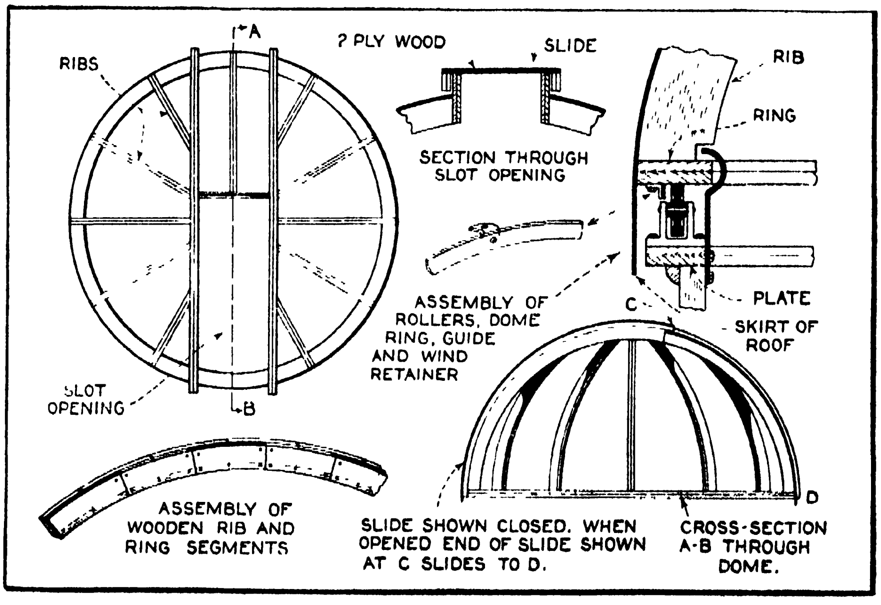
This building may be round or square, but many of those who have "been there," and who speak from actual experience, will swear by the square type of building, because its four corners give room for a small built-in desk, for built-in seats, cabinets, bookshelves, and for a parking place for visitors, who sometimes get under foot in the more constricted, round type of observatory.

THE roof-top observatory of D. B. Pickering, of East Orange, New Jersey, the well-known variable star observer, is a good illustration of the square type. There is no mystery about the building proper, exclusive of the dome; it is simply a square structure built on top of the house. Note that the entrance is not through a trap door in the floor but from the roof through a door. This leaves the floor clear. Pickering did not run a masonry pier to the ground, as many think imperative, but rested the telescope pedestal on cross timbers attached to the roof. Will the vibrations of the house not destroy the good seeing? Pickering's success in variable star observing says at least, "not necessarily." The same bogey was faced when a large telescope was placed on the roof of a 13 story building at Columbia University, but the predicted ruination of seeing due to vibration did not materialize (*Popular Astronomy*, June-July, 1928; also same, Oct., 1926). Pickering saw to it, however, that the immediate flooring of his observatory did not touch the support of his telescope; he also insulated the floor against heat from the house below.

Another square type of observatory is that of George Waldo of Fairfield, Connecticut, designed by J. Ernest G. Yalden of 120 Woodbridge Place, Leonia, New Jersey, a variable star observer. This has a pyramidal "dome" which rotates on a circular track. The side shutter lifts off, while the small level truncation at the top has a lid that tips back. By the way, the shutter should be at least 24 inches wide; a narrower one is a nuisance. It may, if one prefers, be made in two halves, like a sloping cellar door, opening outward.

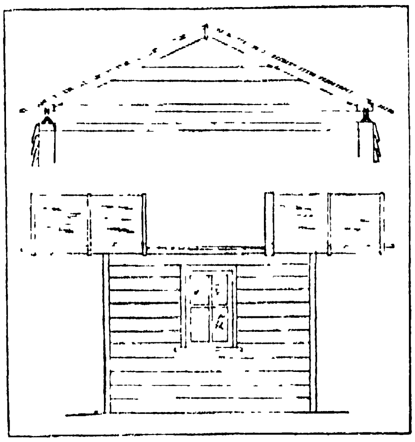
Light weight dome (by B. W. St. Clair)

ALBERT F. SCHROEDER, 1075 Forest Cliff Drive, Lakewood, Cleveland, Ohio, kindly let us see some drawings from which several observatories, including one



A
RIBS
? PLY WOOD
SLIDE
SECTION THROUGH SLOT OPENING
RIB
RING
ASSEMBLY OF ROLLERS, DOME RING, GUIDE AND WIND RETAINER
C
PLATE
SKIRT OF ROOF
SLOT OPENING
B
ASSEMBLY OF WOODEN RIB AND RING SEGMENTS
SLIDE SHOWN CLOSED. WHEN OPENED END OF SLIDE SHOWN AT C SLIDES TO D.
D
CROSS-SECTION A-B THROUGH DOME.

Assembly of a typical observatory dome, after Schroeder in China, have been made. The original drawings can not be reproduced but the accompanying sketches based on them may serve to give ideas concerning a good structure. The main elements are: A solid circular track, for which wood, if leveled well, will do; about eight good rollers (Charles D. Higgs of Fontana, Wisconsin, used roller skate wheels—see *Popular Astronomy*, Aug-Sept. 1928); some kind of device or guide to keep these rollers on the track (here Mr. Higgs used eight more skate rollers bearing sidewise, while the sketch shows Schroeder's method); something to keep the dome from being lifted off by the winds, (Mr. Schroeder uses simple iron hoop stock bent to embrace but not touch the dome ring, as shown on sketch) The maker may juggle and recombine or revise these or other elements to suit his own taste. Past experience with amateur ingenuity in telescope construction gives promise of a wide variety of new ideas; some of which will be good and a few better yet. The average amateur dislikes being pinned down to a standard, inflexible design to copy. He prefers to do most of his own designing.



Courtesy English Mechanics

W. R. Evans' design—gantry type

A good dome ring can be made of ⅞-inch pine stock cut to proper radius, lapped alternately, glued and screwed together The vertical pieces are made in the same way. This makes a heavy dome, but one that will "stay put" in all weather. Any kind of roofing will do, from unsupported canvas, giving the "starved dog" effect, to sheet metal—suit your own skill, taste, patience and pocketbook.

SOME good hints and a few plans will be found in Bell's "The Telescope," Chapter 10, and others in various back numbers of *Popular Astronomy* (see A.T.M., page 260). In the average case, however, an ingenious amateur will prefer to "roll his own," thus giving him the right to take credit for the whole job. We have no "blueprints, instruction pamphlets, or set specifications" of any kind. Those who expect to hire a carpenter to do the job may need these, it is true, but if anyone plans to have it done in that manner the best thing is to go to a professional designer of observatories. The above, which is not too precise a description, was written for the fellow who enjoys doing his own jobs.

Amateur telescope making fans may be interested in knowing that the hobby is still going strong—stronger, in fact, than at any time since 1926. This is the first year in which interest has not dwindled to a tricklet during the hot months.

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The Scientific American Digest

(Continued from page 223)

normally increasing supply. The lessening demand has been due very largely to demonetizing of silver during the latter part of the 19th Century by the principal nations of the world. Demonetization became possible through the enormous increase in gold production that followed invention of the cyanide process in 1887 and development of the gold fields of South Africa, yet a number of countries still retain the silver-gold standard. Most orientals use silver as a medium of exchange almost to the exclusion of gold. Silver may thus be regarded as a second line of defense for the maintenance of the metallic foundation of monetary systems, but the future of its production will be influenced largely by the production of gold *A. E. B.*

The auto-radio receiver is mounted in a box on the running board

Gas Is Big Factor in Aviation Safety

IN aviation a man's life literally "hangs by a thread," but the strength and importance of this "thread" depends on gas, according to *Industrial Gas*.

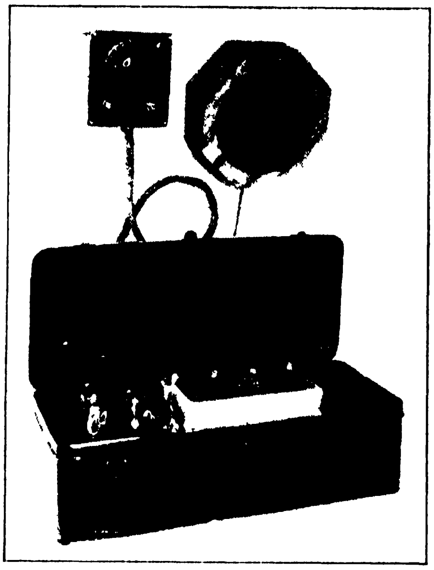
The manufacture of tie rods and tie wire for heavier-than-air machines relies largely on the steady, intense heat of huge gas-fired ovens. These parts, the "threads," are subjected to a temperature of about 300 degrees for six hours for the purpose of driving off any hydrogen that may have been absorbed by the steel wire. This process makes the wire strong and slender in order to assure the least possible air resistance.

Auto-Radio Kit

PRACTICALLY all of the automobile radio receivers that have appeared so far are intended for concealment behind the instrument board or under the engine hood. A new set in kit form, recently placed on the market by the Pilot Radio & Tube Corporation, is rather unusual in that it is designed for mounting on the running board, or possibly in the rumble seat of roadsters or coupés. The new outfit, bearing the name "Auto Pilot," is supplied in kit form and must be assembled, wired, and installed by the individual purchaser, who will find the work easy, interesting and enjoyable.

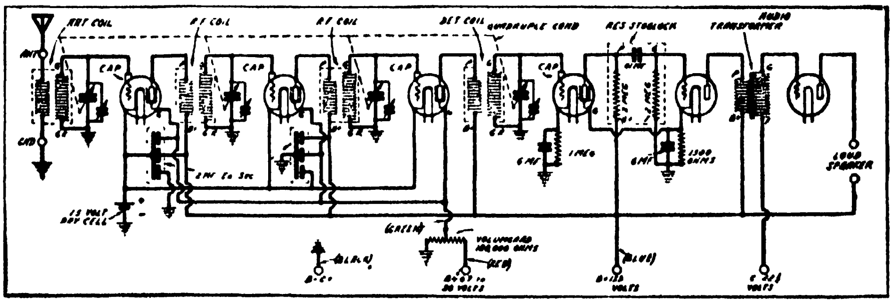
The receiving unit itself is contained in a black japanned steel case. This is 22 inches long, 8 inches wide, and 6⅞ inches high, flat enough to let the doors of all makes of cars clear it by a comfortable margin The set is controlled from the inside of the car by means of a flexible cable which terminates at a control box 5½ inches square and 2 inches deep. The cable is six feet long and is enclosed in a protective sheath of waterproof fabric.

The movement of the tuning dial on the control panel is transmitted to the shaft of the variable condenser by means of two brass chains fastened to pulleys at both ends. These chains slide in separate flexible tubes, and run smoothly in spite of their length. The other devices on the control panel are the usual pilot light, volume control, and filament switch. The volume control is a potentiometer that regulates the voltages to the screens of the R. F. tubes.



The assembled auto-radio in its box; the control panel that is placed in the car; and a small loudspeaker

Electrically, the receiver is of simple but reliable design. It makes use of three stages of tuned R. F., a screen-grid detector, one resistance-capacity audio stage and one transformer stage. All the parts are mounted on a formed and drilled



The circuit of the six-tube auto-radio receiver

aluminum chassis or foundation unit. Six tubes are employed: four 224's, one 227, and one 245. Plate voltage is supplied by three 45-volt "B" batteries.

The radio-frequency gain in this receiver is pushed quite high and little attention is given to selectivity because this matter is taken care of automatically by the necessarily small antenna that is used. For an aerial, a pair of wires strung between the front and rear axles, under the car, has been found very effective. Where the shielding effect of the chassis is too great, a piece of copper screening may be tacked to the inside of the top of the car, or a wire run around the edges of the running boards.

Air Swallowers

ONE of the most common American complaints is the swallowing of air, sometimes called "aerophagy." At least 60 percent of people with disturbances of the gastro-intestinal tract swallow air and belch. In fact, the habit is not associated merely with modern man, since it is referred to in the writings of the ancient Greeks and Romans, including Martial and Petronius. Among the causes particularly for the swallowing of air and its return are rapid eating, gulping of food, and involuntary swallowing of air during breathing With almost every swallow of food or saliva air enters the esophagus and is either eructated at once or goes into the stomach.

Dr. Asher Winkelstein has given special attention to this trouble, and mentions the fact that there is one group who voluntarily swallow air in large quantities and expel it at all times and in all places. These people are usually neurotic and perhaps indulge in this performance as a means of expressing themselves.

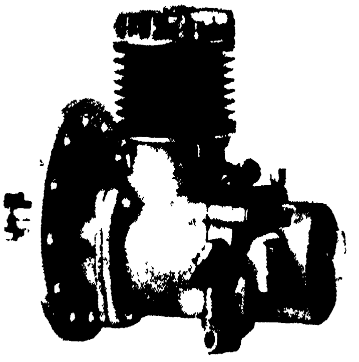
Another group has various forms of gall-bladder, intestinal, heart, or liver disease, with a constant sense of pressure in the abdomen. Having learned that belching will relieve their sense of pressure in the abdomen they swallow air, belch, and thus temporarily obtain a sense of relief. When air is swallowed, it is trapped in the stomach by a contraction of the end of the esophagus and by a spasm of the pylorus through which the stomach empties into the intestines. It requires some time or activity to cause the air to leave.

X ray shows the distended stomach and intestines of an air-swallower

In the control of the condition, Doctor Winkelstein recommends the training of habits so that air will not be swallowed, the use of mild sedative substances, and occasionally instrumental dilation of the end of the esophagus which has not only the instrumental effect but the possibility of powerful psychologic effect. It is, of course, necessary for the physician who examines such a patient to determine definitely that this symptom exists and not anything more serious as, for example, heart disease, intestinal obstruction, or fermentation. *M. F.*

The Heywood Injection Starter

SWINGING the airplane propeller in order to start the engine will soon be entirely a thing of the past. The dangers and discomfort of swinging have been replaced by starters of various types—electric, inertia, hand, and pressure-injection types. The Heywood starter, of the latter type, built by the Sky Specialties Corporation, has been fitted successfully to many engines and in many planes.



Compressor of an injection starter

The Heywood starter consists of a small air compressor, a steel tank, a pressure regulation valve, a starting valve, inlet valves for each of the cylinders, tubing, pressure gage, and primer The weight of the starter is about 30 pounds.

The small air compressor, shown at the top part of the accompanying photograph, is driven off the rear of the engine shaft, requires only one quarter of a horsepower, and can refill the starting tank in one minute.

The tank (not shown in the illustration) has a capacity of about one half of a cubic foot, and holds air at 400 pounds per square inch pressure.

When starting the engine, the pilot primes in the usual way, but the gasoline does not go directly to the cylinders or the manifolds of the engine, but into a small gas chamber on the starter where it is held until the starter trigger is pulled.

After the ignition is switched on, the starter trigger is pulled. The trigger allows the air to be released from the tank and to go to a chamber in the starter where it is routed by means of a rotating disk that is timed on its shaft with the engine. This rotating disk has one large and one small hole, and rotates close to a stationary disk that has as many holes as there are cylinders in the engine. The large hole in the rotating disk registers with the appropriate hole in the stationary disk and allows the compressed air to go through to the cylinder which is in position for a power stroke. This starts the engine in rotation.

Simultaneously, part of the air in front of the rotating disk goes to the gas chamber, and forces the gasoline through a small

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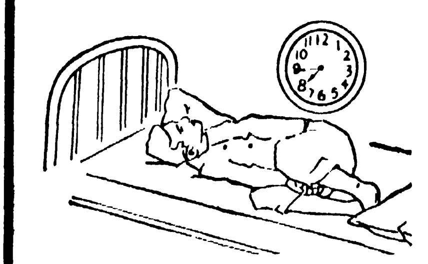

Are you *sure* that you "slept like a log" last night? Or, would a moving picture machine reveal you rolled up like a ball, twisted like a rope or hanging over the side of the bed like a line of clothes. Drs. Johnson, Swan and Weigart took movies of 150 sleepers. The results were astonishing. They showed that a soundly sleeping, healthy man may struggle through forty or fifty different positions nightly, not one of which will be held more than an hour. A description of this extraordinary, scientific experiment, with picture of 33 "sleeping beauty" postures appears in the September HYGEIA, the Health Magazine of the American Medical Association. It is a real contribution to an all important subject.

COLDS

and

The

Other

Fellow

You have heard that colds are contagious, and you would like to know just how they are spread so that you can allay unnecessary fears and sensibly avoid the cold infection. The September HYGEIA contains a timely discussion by Dr. Richard Ash especially directed to parents and teachers, explaining the way colds spread and how to keep yourselves and your children from catching the debilitating cold germ—a most helpful article with the cold season just around the corner.

Other Vital Features in

HYGEIA

"How Much Should the Patient Know"—"The Tardy but Tempting Tomato"—"The Movies in Medicine"—"The Undernourished School Child"—"Questions and Answers"—these are only a few of the features of the September HYGEIA. Every article is written by an authority who proves theory with practice. The language of HYGEIA is non-technical, simple and even entertaining. Every issue is a gold mine of reliable health information. As you value your health you will value HYGEIA.

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carbureter nozzle that projects into the center of the rotating disk and up to the small hole that also registers with a hole in the stationary disk, and allows gas to flow to the appropriate cylinder

There is therefore simultaneous rotation of the engine and injection to the cylinders from a small gas supply of a richly carburetted mixture. The starter rotates the engine at 400 to 500 revolutions per minute.

It is claimed for the starter that it will function under almost any weather conditions, that it does away with the danger of back-firing, and that it is simple, dependable, and easy to operate —*A. K*

Explosions in the Laboratory

THE hazards of industry are seldom considered as concerning the research worker in the laboratory. Nevertheless, the chemist, the pathologist, the bacteriologist, and indeed even the physicist are constantly working with chemicals, germs, poisons, and electrical materials which can put them in jeopardy. Dr. John A Marshall has reported an unusual incident in the laboratory in the University of California devoted to the staining of tissues.

In the incident reported, sections of bone and teeth were being stained by the silver nitrate method. The dishes containing a solution of ammoniacal silver oxide were left standing in the sun from Saturday noon until Tuesday morning. There were traces of alcohol in the silver solutions, carried there by the pieces of tissue which had been previously immersed in alcohol. The sunlight hastened the chemical change between the silver, the chemical, and the alcohol. As a result a highly explosive, sensitive, and unstable compound called silver fulminate developed When the dish was taken up to be emptied and cleaned, it was warm from the sun and the mere movement of the liquid caused the fluid to explode.

As a result the warning is issued that one should never work in the direct sunlight with silver solutions or leave bottles or dishes containing them exposed. Every precaution must be exercised to keep out ethyl alcohol, and containers for silver solutions should be immersed promptly and carefully in cold water. *M F.*

Inventor of Ethyl Gasoline Scores Again With New Refrigerant

THE "big news" of the recent meeting of the American Chemical Society in Atlanta was the announcement of a new refrigerant, non-inflammable and non-toxic, by Thomas Midgley, Jr. Anything that Midgley announces is apt to be big news, for he has a way of striking out on entirely original lines and developing something that boosts General Motors stock. Midgley is the chemist who discovered the anti-knock properties of tetra-ethyl lead, and he was the first president of the Ethyl Gasoline Corporation. Now he has turned his genius to the perfecting of a refrigerating medium that his company can use in household electric refrigerators without the remotest risk of danger from leaky coils. His discovery of the suitability of dichlorodifluoromethane gives promise of the early use of refrigeration for air cooling in homes and theaters and other public gathering places where refrigerating engineers have hesitated to risk accidents with poisonous or explosive refrigerants.

Dichlorodifluoromethane is made from carbon tetrachloride (a common fire extinguisher) and antimony trifluoride. Human beings and animals can inhale vapors of dichlorodifluoromethane without the least ill effects. It is not only non-inflammable, but it is actually a good fire extinguisher. Of course, it is stable and possesses the necessary vapor-pressure characteristics for a good refrigerant. It boils at -30 degrees, centigrade, and freezes at -155 degrees, centigrade. It is non-corrosive with steel, aluminum, copper, tin, and monel metal.

Thus, while proponents of diverse standard refrigerants were arguing the question of which was the safest and best, Mr. Midgley settled the question in characteristic style by creating a new one which left no grounds for argument.—*A. E. B.*

The Future of the Aviation Industry

THE Curtis Publishing Company has recently issued a magnificent book summarizing a long and thorough survey of the aviation industry. The study is most comprehensive, covering planes, schools, markets, speed, comfort, air transport, financial, and many other aspects of the industry. The material presented is accurate but not new. What is valuable is the conclusions of careful and independent observers as to the "underlying trends." These conclusions appear in the very first chapter and are of interest to any one who is at all concerned with the future of American aviation We quote from this chapter in part.

"We have confidence that the aviation industry will develop into a large and sound industry. This confidence is based on two facts. First, the idea of air travel is sound. Air travel is certainly the quickest, we believe it can be made the most comfortable, and ultimately we think probably the least expensive method of long distance travel."

"Enthusiastic service appears to be more true of aviation than any other form of transportation and also more true of aviation than of any other industry we have studied. . . ."

"It seems to us likely that ultimately all first-class mail will be carried by airplane wherever an airplane can speed delivery; that a majority of 'Pullman class' day travel for distances in excess of 100 miles will be by air, that air package transport may exceed first-class mail and passengers combined."

The report is equally enthusiastic about the possibility of privately owned planes having a large market. The findings are qualified, however: "If through the autogiro or some other principle, it comes about within the next five years, that planes when they lose speed will settle to the ground without damage, if they can be taken safely into and out of a four-acre lot, and if a person with average mechanical training can in a short time at small expense learn to fly a plane safely, and if, furthermore, planes are sold at prices comparable with automobile prices, within fifteen years, there should be 1,000,000 privately owned planes in operation with an annual market of 250,000." This view defines at least the problem before our constructors and they will certainly do their utmost to meet the challenge successfully.—*A. K.*

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

WILL THE WOOD INDUSTRIES OF AMERICA FOLLOW BEATEN PATHS OR BLAZE NEW TRAILS deals with potentialities of cellulose and lignin. The rise in the production of wood plastics has been phenomenal. *National Lumber Manufacturer's Association, Transportation Building, Washington, D.C.—Gratis.*

THE AMMONIA-CHLORINE TREATMENT OF WATER by J. F. T. Berliner is a digest and bibliography of the subject. *National Ammonia Company, Inc., Frankford P. O., Philadelphia, Pa.—Gratis.*

THE OBSTACLES AND PITFALLS OF INVENTORS, by Joseph Rossman, Ph. D., gives the views of a chemical engineer who is an Associate Patent Examiner, U. S. Patent Office. *Address Joseph Rossman, U. S. Patent Office, Washington, D. C. Gratis*

WORKING PROPERTIES OF TANTALUM (Technical Publication No. 278, Class E, Institute of Metals, No. 105. The American Institute of Mining and Metallurgical Engineers) by M. M. Austin. *American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York City.—25 cents.*

SCIENCE IN THE KITCHEN (Radio Publication No. 58, University of Pittsburgh) consists of a series of popular radio talks broadcast by research specialists of the Mellon Institute for Industrial Research, Pittsburgh, Pa. *Radio Manager, University of Pittsburgh, Pittsburgh, Pa.—60 cents.*

TWENTIETH CENTURY WHALING (Bulletin New York Zoological Society, Jan.-Feb., 1930. Vol. XXXIII. No. 1,) by Dr. C. H. Townsend, is a splendid discussion of an ever popular subject written by the Director of the New York Aquarium. *New York Zoological Society, Zoological Park, Borough of the Bronx, New York City.—35 cents.*

FLORA OF THE INDIANA DUNES by Donald Culross Peattie is a handbook of the flowering plants and ferns of the Lake Michigan coast of Indians and of the Calumet district. This 432 page book will be a boon to all who visit this locality. *Field Museum of Natural History, Chicago, Ill. $2.20, mailed.*

AIRPORTS IN LATIN AMERICA (Trade Information Bulletin, No. 696, U. S. Department of Commerce) is a bulletin describing the airports, landing fields, and weather conditions in 26 countries of Latin America. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

AUTOMOTIVE EQUIPMENT AND CONSTRUCTION PREFERENCES IN FOREIGN COUNTRIES (Trade Information Bulletin, No. 695, U. S. Department of Commerce) is a bulletin noting many changes in foreign preferences as regards automobile construction, equipment, and color. *Superintendent of Documents Washington D. C.—10 cents (coin).*

CORN IN KANSAS (Vol. XLVIII. No. 191, Report of the Kansas State Board of Agriculture for the Quarter Ending September, 1929) is the subject of this fully illustrated 283 page book. While it is intended primarily for distribution among Kansans, outside requests are honored where the book is really desired. *Address J. C. Mohler, Secretary, Kansas State Board of Agriculture, Topeka, Kansas*

CORROSION OF ALLOYS SUBJECTED TO THE ACTION OF LOCOMOTIVE SMOKE (Technical Publication 293 Class E, Institute of Metals, No. 104) by F. L. Wolf. *American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York City. 25 cents.*

REPTILES OF MARSHALL FIELD NORTH ARABIAN DESERT EXPEDITIONS, 1927-1928 (Publication 273 Zoological Series, Vol. XVII No 6) by Karl P Schmidt. *Field Museum of Natural History 25 cents.*

THE SOVIET AND RELIGION (No 261 of International Conciliation) contains the debate in the House of Lords, decree of All-Russian Control Committee, and the Protest of His Holiness Pope Pius XI. *Carnegie Endowment for Industrial Peace, 44 Portland St., Worcester, Mass.—5 cents.*

LUBRICATION OF HYDRAULIC POWER GENERATING EQUIPMENT (Vol 16, No. 5 of Lubrication May, 1930) describes the problems of oiling these ponderous machines *The Texas Company, 135 East 42nd St, New York City.—Gratis.*

PROPERTIES OF HAYNES STELLITE is the first of a series of booklets embracing Haynes Stellite products, their uses and methods of application. *Haynes Stellite Company, Kokomo, Indiana—Gratis.*

THE 92 ELEMENTS is a folder giving their numbers, names, symbols, atomic weights, melting points, and years of discovery. *P. C. Kullman & Co., 110-116 Nassau St., New York City.—Gratis.*

ACUTE RESPONSE OF GUINEA PIGS TO VAPORS OF SOME NEW ORGANIC COMPOUNDS. I. ETHYLENE DICHLORIDE (Reprint No. 1349 Public Health Reports, Public Health Service, U. S. Treasury Department) by R. R. Sayers, W. P. Yant, C. P. Waite and F. A. Patty. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

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Serpents of the Eastern States (Bulletin No. 3, Vol. XXXII) by Dr. Raymond L. Ditmars, is a comprehensive study of the harmless and dangerous snakes in the region covered, which inclueds New England, parts of New York, Pennsylvania, and New Jersey. *New York Zoological Park, New York City. 35 cents, not gratis as previously stated.*

Diamond Core Drill Fittings (Commercial Standard CS17-30, Bureau of Standards, U. S. Department of Commerce). *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

An Annotated List of the More Important North American Forest Insects (Miscellaneous Publication No. 74) by F. C. Craighead and William Middleton, gives a list of insects and the damage they do. There is an excellent bibliography. *Superintendent of Documents, Washington, D. C. 10 cents (coin).*

Direct Bone Formation in the Antler Tines of Two of the American Cervidae, Virginia Deer and Wapiti (Zoologica, Vol. XI, No. 3) by Charles V. Noback, Ph D., and Walter Modell, B. S. *New York Zoological Society, Bronx Park, New York City, N. Y. 65 cents, mailed.*

Timber Growing and Logging Practice in the Northwest (Technical Bulletin No. 166, U. S. Department of Agriculture) by Samuel T. Dana, with an introduction by William E. Greeley, treats of the measures necessary to keep forest land productive and how to produce full timber crops. *Superintendent of Documents, Washington, D. C.—40 cents (money order).*

Vitreosil deals with vitreous silica and forms a valuable treatise on fused pure quartz and fused pure silica. *The Thermal Syndicate Limited, Schenectady and Atlantic Avenues, Brooklyn, N. Y. -Gratis.*

Studies in the Electro-Deposition of Metals (University of Illinois Bulletin No. 206, Engineering Experiment Station, Urbana, Ill.) by Donald B. Keyes and Sherlock Swann, Jr. *University of Illinois, Urbana, Illinois.—10 Cents.*

Propagation of Aquatic Game (Farmer's Bulletin, No. 1612, U. S. Department of Agriculture) by W. L. McAtee. Full information regarding a small but growing industry, fully illustrated. *Superintendent of Public Documents, Washington, D. C.—10 cents (coin).*

Manufacture and Properties of a Cellulose Product (Maizolith) from Cornstalks and Corn Cobs (Miscellaneous Publication No. 108) by C. E. Hartford, describes the utilization of agricultural wastes. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

The Relation of Carbon Residue to Lubricating Performance. Lubrication, January, 1930. *The Texas Company, 117 Battery Place, New York City.—Gratis.*

Foundry Patterns of Wood (Commercial Standard CS19-30, Bureau of Standards, U. S. Department of Commerce) contains a fine plate giving standard pattern colors. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

Laboratory Tests of Reinforced Concrete Arch Piles (Bulletin No. 202, Engineering Experiment Station, University of Illinois) by Wilbur M. Wilson. *University of Illinois, Urbana, Ill.—55 cents.*

Weather and Health (Bulletin No. 75 of the National Research Council) by Professor Ellsworth Huntington is a scientific effort to determine the relation between weather and health. *National Research Council, Washington, D. C.—$2.00.*

Warning Agents for Methyl Chloride in Refrigeration Systems is a contribution to the household refrigeration industry from the *Roessler & Hasslacher Chemical Co., 10 East 40th St., New York, N. Y.—Gratis.*

Slope Corrections for Echo Soundings (Special Publication No. 165, Coast and Geodetic Survey, U. S. Department of Commerce) by A. L. Shalowitz, deals with the "fathometer" invented by Dr. Reginald A. Fessenden and the proper corrections to be made. *Superintendent of Documents, Washington, D. C. -10 cents (coin).*

Durability Tests of Spar Varnish (Bureau of Standards Reprints, No. R.P. 146). *Superintendent of Documents, Washington, D. C. 5 cents (coin).*

A Young Man Looks at the Eastman Kodak Company gives a quick glance at a great industry and the opportunity that it offers to ambitious men. *Published by the Training Department of the Eastman Kodak Company, Rochester, N. Y. Gratis.*

Sickness Among Industrial Employees (Reprint No. 1347, Public Health Reports,) by Dean K. Brundage. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

Triangulation in Colorado (1927 Datum) (Special publication No. 160, Coast and Geodetic Survey) by Oscar S. Adams. *Superintendent of Documents, Washington, D. C.—15 cents (coin or money order).*

Mining in the Fortymile District Alaska (Bulletin 813-C, Geological Survey, Department of the Interior) by J. B. Mertie, Jr. *Superintendent of Documents—Washington, D. C. -5 cents (coin).*

International Trade in Mica (Trade Promotion Series No. 95, U. S. Department of Commerce) gives valuable information about this type of mineral deposit. *Superintendent of Documents, Washington, D. C. 10 cents (coin or money order).*

Our Point of View

The International Bank

(Continued from page 175)

contention among world powers is a reasonable certainty to all acquainted with European history.

If this new bank cuts deeply into the profits of central banks of England, Germany, and France, its existence may be brief. Pretexts for its dissolution could quickly be produced. Its attitude during war, or even a period of strained relations between European powers, would be difficult if not impossible. Most of its optimistic founders calmly ignore the possibility of future European wars in forecasting its future, but war comes unbidden to most of his hosts.

We welcome the new bank and are proud that American bankers were its originators. Undoubtedly American membership on its staff will involve us still further in world affairs, but we are so thoroughly involved already that the new bank adds little to our commercial ties with Europe and nothing to our political responsibilities.

CIVIL AND MILITARY AUTHORITIES

THE time is near when our civil authorities will be obliged to pay more heed to their military and naval advisers than they have in the past, else the interests of the United States will suffer The substance of the defense of the naval treaty by our delegation was that "it was the best we could get because both Japan and England had out-built us, and naturally we could not expect them to scrap ships already built or building." Yet in 1921, Mr. Hughes, ostentatiously refusing to consult with our naval officers, did scrap our battleships and battle cruisers. Americans should remember that, under the auspices of Mr. Hughes, we were willing to sacrifice naval superiority in 1921-22; and in 1930, Japan took advantage of her actual naval position to upset the naval ratio between the two countries. We will be under a handicap during the life of this treaty but we can overcome it easily in the period 1935-40 if we have really learned the obvious lesson.

OUR NEW MERCHANT MARINE

ONE of our few industries that is doing better in 1930 than in 1929 is shipbuilding, and for this we can thank the recent legislation by Congress, specifically designed to encourage the rebuilding of an American merchant marine. Four of our largest shipbuilding companies show an increase of 21 percent in the number of men employed. This increase is spread through all the skilled trades and crafts needed in the construction of a modern sea-going vessel. The support of Congress was extremely timely for under the severe competition of foreign companies that can build and operate vessels with cheaper labor, our shipyards were being abandoned and the many trained artisans necessary to that industry were being dispersed to other trades.

Efficient shipyards and skilled shipwrights are essential to our foreign trade in peace and to our fleet in war. Other nations give much care to their shipbuilding industry. Thus, at the London Conference, Japan insisted that she be allowed special permission to replace some of her submarine tonnage before it become obsolete in order to insure permanent employment to her trained shipbuilders. If with her present financial burdens, Japan can subsidize her shipyard workers, we can certainly afford to reassemble our workers before they are entirely absorbed into other trades.

FRENCH EVACUATION OF THE RHINELAND: INCREASE IN ITALY'S MILITARY FORCES

ALMOST simultaneously with the announcement of the evacuation of the Rhineland by the French forces in accordance with the provisions of the Dawes-Young plan for reparations, comes the news of further increases by Mussolini of Italy's land, sea, and air forces. At first glance these two occurrences may seem a mere coincidence, but it is well known in Europe that France does not wish to confront Italy with a large part of her army in Germany. With Italy scarcely concealing her conflicting ambitions, France naturally hastens to reduce her differences with Germany, re-group her armies, and strengthen her Italian frontier. Franco-Italian jealousy may prove a blessing to Germany.

To view further the already complicated European picture, in parts of Jugoslavia anti-Italian demonstrations have taken place. Americans can scarcely imagine the war-scourged Serbians considering another resort to arms so soon, but Mussolini regards the French-Jugoslavian menace sufficiently real to increase Italian taxes to add to his armed forces. As Mussolini has heretofore steadily reduced imposts on his heavily burdened people, the significance of this increase is apparent.

THE SEA FRONTIERS OF THREE NAVAL POWERS

THE London Conference called the world's attention to a wet triangle that can be somewhat loosely inclosed by lines drawn from the south point of Formosa to Guam, thence to Hong Kong, then returning to Formosa. This area of mixed land and water includes the sea frontiers of the three naval powers, Japan, Great Britain, and the United States. In a political sense, this wet triangle resembles the "buffer states" of a generation ago, the most famous being the Balkan States whose boundaries were fixed by various European conferences to reduce the risk of war between the three land empires, Russia, Austria and Turkey.

A glance at a world chart will reveal the importance of this area navally and commercially. It controlls the routes from the Far East to Europe and to Australasia, and the routes from the west coasts of the Americas to the Philippines, Southern Asia, and India. For this reason, Great Britain insisted upon the right to create an impregnable first-class naval base at Singapore, when at the Washington Conference Japan succeeded in restricting any further fortifications at Hong Kong or Manila. We did not appreciate the necessity of naval bases for our fleet and in consequence, our nearest naval base, Honolulu, is almost 5000 miles distant. It is hoped that our Delegation to the Naval Conference in 1935 will go with a mandate to redress the naval balance in this area.

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Books Selected by the Editors

Simplified Aerodynamics *By Alexander Klemin, Prof. Aero. Eng., N. Y. Univ.*

IT is indeed an accomplishment when an author can take an abstruse subject like this one is and expound it in language the average intelligent person can understand. Prof. Klemin, however, has done it most admirably and has produced an indispensable reference that should be in the possession of every pilot, every mechanic, and every person seriously interested in aviation. Reduced to the very simplest mathematics, physics, and mechanics, little difficulty will be experienced in mastering the subject and applying the knowledge successfully. A much needed work splendidly handled. $3.65 postpaid.

Playing Airplane *By J. F. McNamara*

IF you have a youngster who keeps continually asking you questions about airplanes, we suggest that you get this book and carry out the plan outlined therein. We will warrant, even if you are an experienced flyer, that not only will you get the proverbial "barrel of fun" but also you will learn some things about flying that you hadn't thought of. A most happy conception of fun and information by an R.C. Lieutenant whose children have been brought up near Roosevelt and Mitchell Fields. $2.65 postpaid.

My Automobile—*By H. F. Blanchard*

A SECOND edition completely revised and reset giving the step-by-step details for locating trouble and making minor repairs. The front wheel drive is given the final chapter and the whole is written for those who need information in the most clear and ready form. The author is technical editor of *Motor*. Fine format. 227 illustrations. $3.65 postpaid.

Parachute—*By C. J. V. Murphy*

TRUE tales taken from the journal of the Caterpillar Club, to tell the full story of the history and development of the parachute from the experience of individual performance. A well developed, chatty narrative. $2.65 postpaid.

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How the Derrick Works *By Wilfred Jones*

YOU will be surprised to learn how many people in these offices have borrowed the review copy of this book to read how the derrick is handled on the building which is going up across the street. The plentitude of illustrations are shade wood-cuts and fully bring out the details as well as the romance of construction. $2.20 postpaid.

A Dictionary of Color *By A. Maerz and M. Rea Paul*

UNDOUBTEDLY this is the most ambitious and certainly it is one of the most complete works of its kind that we have seen. A well rounded outline explains the field of text, references, frequency of use of names, polyglot table, and bibliography. Sixty-six color plates with corresponding skeleton plates naming the colors, cover every conceivable shade throughout the range and this is followed by a brief history of color standardization, an index of color names, and notes thereon. It would be difficult to see wherein this work could be enhanced and for anyone having to do with color in all of its applications, this is an invaluable reference. 9 x 11½. $12.50 postpaid.

German-English Technical and Scientific Dictionary—*By A. Webel*

THERE are several features of this most excellent work that will appeal at once to one familiar with the usual reference dictionary. English script is used and the word sought stands out to the eye for the reason that following explanatory text is indented sufficiently to give good white margin on the left— a point most inexplainably ignored in most dictionaries. No jumble of explanatory pronunciations, derivations and deviations follow the word, for infinite care has been taken to select the most authoritative translation scarcely any individual text exceeds three lines. It is just such a work as scientists, students, writers, and translators need, for it grants some knowledge on the part of the seeker and does not burden him with non-essentials. Chemistry, mathematics, metallography, electrical engineering, physiology, medicine, fuels, woods, oils, brewing, dyeing, paper making, textiles, and so forth, are amply covered. A monumental work of 20 years compilation. $10.75 postpaid.

New International Year Book —*H. T. Wade, Editor*

PERSONALLY we find this reference one of the most useful in our library and one reason beyond the excellence of the material and its wide scope, as the name implies, is the simplicity of format and straightforward way of running throughout the book in alphabetical arrangement of subjects irrespective of grouping. Busy people wish to find their references in the easiest, simplest, and most natural way and we find this compendium of the world's progress for the year 1929 fulfills these requirements. Cloth. $7.00 postpaid.

Number, the Language of Science —*By Tobias Dantzig, Ph. D., Prof. Univ. of Md.*

HERE is a book of a "different" kind, one which will delight all those whose leanings are philosophical—thinkers, figurers, delvers, and others whose instinct drives them to burrow below the superficial appearances of things. It isn't a mere schoolbook on algebra, geometry, calculus, or any other horrible kind of formal mathematical torture—plenty, too many, of these have been written already—but it occupies a different corner of thought and science. For example, some of the typical subjects are: the origin of zero, the use of symbols, the notion of infinity, transcendentals, amicabie numbers, perfect numbers, various theories of number. No school book contains the same stuff and if it did it would be deadly dull, while this book is lively bright. If a reader has had high school mathematics he will be able to grasp its contents, and whether he likes or dislikes mathematics proper, the pure philosophical interest of the book will hold his attention and cause him to exclaim at least once per page, "Well, I never thought of that before." The author also is Lecturer in Mathematical Physics at the U. S. Bureau of Standards. $3.70 postpaid.—*A.G.I.*

From Recent Publications

FIELD BOOK OF PONDS AND STREAMS *By Ann Haven Morgan, Ph.D., Prof. Zoology, Mt. Holyoke*

THE finest book on pond and stream life—tiny animalcules, rotifers, leeches, aquatic insects, and larger animals—which has yet appeared, will be the verdict of all lovers of aquatic life, whether amateur or professional. Professor Morgan has anticipated the needs of all classes of students of water life and has produced a guide which is at once technical, readable, and comprehensive. The illustrations are excellent and are arranged in graphic form. This convenient pocket book (7 x 4½ x 1 inches, 448 pages) will be suitable to take on tramps and to camps. $3.65 postpaid.—*A.G.I.*

EXPLORING FOR PLANTS—*By David Fairchild*

AN intimate narrative of a scientist's adventures in little known lands, based on notes of the Allison V. Armour expeditions. Dr. Fairchild is a botanist of note with a remarkable record of doing things, the results of these expeditions being the introduction into this country of many useful new plants and trees. Ranking as a scientific book, its charm for the average reader lies in the ease of style and the joyous appreciation of life looked at from every angle. The story is so smooth one assimilates the botany with no effort whatsoever. Good science, good reading, good writing. We highly recommend it. Abundantly illustrated. $5.20 postpaid.

ROOSEVELT: THE STORY OF A FRIENDSHIP *By Owen Wister*

AS might be expected this is a sympathetic, manly word portrait and incidentally quite a autobiography. With his charming style which still lists "The Virginian" among the best sellers, the author covers 40 years of interesting friendship, reaching through the years from college days to the end. It is also an interesting study of the Familiars (as they are denominated) whose lives intimately touched that of our great President. A book that cannot be overlooked. $4.20 postpaid.

ST. AUGUSTINE *By Giovanni Papini*

THE same vivid, fervent style that made the "Life of Christ" one of the most popular works of its time in every country of the civilized world, is displayed in this story of the Roman scholar who became a saint and a Christian philosopher. Now on the 15th centenary of St. Augustine's death, we have this most sympathetic and understanding story of his life, which has become one of the greatest moral and intellectual forces that Christianity has produced. It should be made a "must read" on every list. $3.20 postpaid.

THE LAST PARADISE—*By Hickman Powell*

BALI, a small island in the Dutch East Indies, still retains much of the manners and customs of the days when it was subject to Hindu influence. The story depicts the writer's life with a native family in all its serene peacefullness and topsy-turvy excitements. $4.20 postpaid.

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THIS is the story of an educated man, as the frequent Latin phases would indicate. As such, one will appreciate that the philosophical introspections and the search for underlying bases of emotion and thought are of a more penetrating and analytical kind than has appeared in any war book to date. It is again the story of a private of officer caliber, but the setting is the life, in and out of the trenches, of an English battalion. So faithfully does the author strive to record actual conversation, that one rather tires at the redundant use of three or four expletives. None the less it is a gripping story and quite different from all the others. $2.65 postpaid.

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"SOUNDINGS" by the same author will be remembered as a very popular novel of 1925. Here again we find the same sureness of handling and dramatic quality. It is the story of two brothers of fortunate circumstance who love the same girl and carry through the war experience, meeting the crises of love and valor with undiminished attachments. A most readable story. $2.65 postpaid.

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THE TECHNICAL ARTS AND SCIENCES OF THE ANCIENTS—*By Alfred Neuburger*

WITH considerable enthusiasm we call attention to this book we have always longed for. To get in such condensed form things relative to arts and sciences that we have searched for in libraries for days, is a great satisfaction. The scope is very wide and each subject is adequately and evenly treated a rare virtue. Our knowledge of metallurgy of the ancients is quite considerable and here we have each metal treated by itself; for instance, how interesting to trace the origin of the blast furnace! Here we plumb the secrets of the ancient jeweler and see his faint attempts at mass production, and can follow on trade after trade as well with equally good results. Some of the illustrations are classic but most seem unfamiliar. There are 676 illustrations and the half-tones are well printed on coated paper which makes a handsome though heavy book. This volume is indispensible as a reference for almost any library, even a small one, for it is a great treasure house of entertainment as well as cultural information. It is one of the most interesting we have seen in months. $10.25 postpaid.
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STANDARDS AND STANDARDIZATION—*By N. F. Harriman, Bur. of Standards*

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Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Similar Food Trademarks Allowed

IN a recent decision, First Assistant Commissioner Kinnan held that the Lush'us Products Company, of Chicago, Illinois, is entitled to register as a trademark for canned peas, a composite mark consisting of the representation of a chef holding a dish of peas in one hand and lifting the cover of the dish with the other, together with the words "Lush'us Peas," which words are disclaimed, notwithstanding the prior adoption and use by the California Canneries Company of the term "Lusk's Luscious" as a trademark for canned fruits and vegetables

The ground of the decision is that the two marks have nothing in common but the descriptive word "luscious" and since no one is entitled to the exclusive use of the word, there is no likelihood of confusion by reason of the use of the two marks.

After stating that the word "luscious" was obviously descriptive of the goods and it is a matter of common knowledge that it has long been applied to both fruits and vegetables, the First Assistant Commissioner said

"No one is entitled to exclusive appropriation of the word The opposer is only entitled to exclude others from using this word in the particular and distinctive way it has used the word on its goods, that is, in connection with the word 'Lusk's.' The applicant is likewise entitled to use this word, misspelled as it is shown, in connection with the other distinctive features which constitute the entire mark This descriptive word, which is open to everyone to use in connection with the goods of this character, being the only feature of similarity between the two marks, it is believed the opposer cannot prevail "

Concrete Mixer May Be Beautiful

THE Court of Customs and Patent Appeals has held that a specific design for a concrete mixer truck body and frame constitutes proper subject matter for a design patent, and has overruled the decision of the Patent Office refusing an applicant a design patent, according to *The United States Daily*.

The beauty and ornamentation requisite in design patents is not confined to such designs as may be found in the "esthetic or fine arts," the majority opinion states. Tools and mechanisms which are patentable because of their utilitarian qualities, it was further ruled, also may be properly the subject matter of design patents if they possess qualities which the law requires.

Articles of manufacture, the ornamentation of which, owing to their nature, are of no concern to anybody, are not proper subject matter for design patents, the majority opinion states, but held that the particular article did not come within this class.

While the concrete mixer has movable parts, there is nothing connected with the mechanism, or with the machine as a whole, which produces such a multiplicity of designs, the opinion states, as to require the refusal of a design patent.

In the dissenting opinion, it is contended that the design disclosed and claimed does not represent patentable subject matter. "It has escaped our observation," the two members of the court state in their dissenting opinion, "if the pulchritude of articles like concrete mixers has ever excited any great public consideration "

Bottle Cap Not Mark for Milk

RECENTLY First Assistant Commissioner Kinnan held that the Walker-Gordon Laboratory Company, of Plainsboro, New Jersey, is not entitled to register, under the Act of 1905, as a trademark for milk, a mark defined as consisting of a "substantially silver colored cap for milk bottles."

The ground of the decision is that the alleged trademark is a mere color of the container of the goods or a substantial part thereof

In his decision, after noting the grounds above stated, on which the examiner refused registration, and applicant's argument that, by reason of its long use of such colored bottle caps, that color constituted a trademark, the First Assistant Commissioner said:

"It is well settled that mere color aside from some particular symbol or design, such, for example, as a circle, square, triangle, cross, or star, cannot constitute a valid trademark. (Decisions cited.) There is no contention here that it is new to employ a metal cap upon a milk bottle which is attached to the bottle by being bent down over the top much in the way the applicant uses the cap. This being true the applicant is merely seeking a trademark for the color of the cap of the bottle which contains the goods "

The First Assistant Commissioner further noted patent No. 531,796, disclosing and claiming a "tin-foil cap for milk bottles," and said·

"Since tin-foil is either what the applicant here employs or is substantially the same and has a substantially silver color, the registration sought by the applicant would, if granted, be in effect a perpetual patent upon a tin-foil milk bottle cap. The Hall patent expired 18 years ago. If registration were granted the applicant neither Hall nor the public could use the device of that patent without infringing the applicant company's trademark. It is obvious enough under these conditions registration must be refused."

Fly Sprays to be Correctly Labeled

FLY sprays for animals are not "100 percent effective," or "safe," or "nonpoisonous," or "harmless," and neither do they "prevent infectious diseases," nor do they "increase milk production" above normal, and if they are claimed to be effective for longer than 8 hours they are open to question, says Dr. C. C. McDonnell, in charge of insecticide control, Food, Drug, and Insecticide Administration, the organization of the U. S. Department of Agriculture which enforces the Federal Food and Drugs Act, the Federal Insecticide Act, and other Federal regulatory laws.

"There is a marked difference in the action of sprays on various species of flies, and broad claims to the effect that a product is effective for all flies are unwarranted," says Doctor McDonnell. "In defining the action of fly sprays, a distinction should be made between preparations that actually kill flies and those that only repel them."

Not only must the label on fly sprays be free from false or misleading statements, but if the product contains any inert ingredients the label must state the name and percentage of each inert ingredient, or the name and percentage of each active ingredient and the total percentage of inert ingredients

Name for Glass Must Not Mislead

USE of the word "Jena" either independently or in conjunction with the word "Glass" will be discontinued by a corporation in the sale of medicinal supplies and syringes designed for use by the medical profession.

According to a stipulation agreement between this corporation and the Federal Trade Commission, the company will not use the word "Jena" in any way as descriptive of its product so as to mislead the public into the belief that its product is Jena glass, which is understood by the scientific and professional world to be that glass manufactured by a competitor of the respondent company.

(Names of individuals or firms signing stipulation agreements are not mentioned in the commission's press releases or publications, but the facts in each proceeding are presented to show methods of competition condemned by the commission as unfair, for the guidance of industry and protection of the public.)

Refrigerator Trademarks Clash

IT has been held by Assistant Commissioner Moore that the McKee Refrigerator Company is not entitled to register, as a trademark for refrigerators, the term "Iced-Aire," both because it is confusingly similar to the term "Frigidaire" previously used by the Frigidaire Corporation, of Dayton, Ohio on the same goods and because it is descriptive of applicant's goods.

In his decision, after noting the holding of the examiner of interferences that the notation Frigidaire is descriptive and therefore not owned by the opposer, and the use of that notation would not therefore support a claim to damage, the Assistant Commissioner said:

"That it is not necessary, in order to sustain an opposition, that the opposer shall own the trademark, registered or not, before he can oppose the registration of the mark to another person, has been held in many decisions, both by this office and by the Court of Appeals of the District of Columbia. . . . A comparison of the two marks shows that they both have the same ending and the same suggestive meaning, namely, that the air as in a cold state. While the word Iced and the word Frigid do not look alike, yet it is believed that, since they convey the same meaning, their concurrent use on refrigerators would be likely to cause confusion or mistake in the mind of the public as to the origin or ownership of the refrigerators to which the marks are appropriated."

With reference to the character of the marks, after stating that the examiner of interferences did not exceed his authority in holding the word descriptive, he said:

"The mark Iced-Aire, when applied to refrigerators, would convey no other meaning than that the air is rendered cold by the application of ice, and, if the applicant's refrigerator does not operate on this principle, then the mark is deceptive and, in either case, should not be registered."

"Special" Price Must be Special

MISREPRESENTATION of the regular price of a course of instruction as a "Special" price, will be discontinued by an individual engaged in the sale and distribution of certain formulae and courses of instruction in resilvering and replating metal goods, the respondent having signed a stipulation agreement to this effect with the Federal Trade Commission.

Specifically, he agrees to cease and desist from the use of such a statement as "I will send all for only 5 dollars, the regular price being 10 dollars, but for a limited time only the price has been reduced to 5 dollars" when such is not the fact.

He agreed also to stop using the word "Special" to designate the price of his products when in fact such price is not special but is the regular and customary price asked in the usual course of business.

The respondent further agreed to desist from the statement "I am the sole owner of 14 patents, grants, and copyrights" so as to imply and mislead the public into believing that he actually owns the specified number of patents, grants, and copyrights, all of which relate to the art of plating or the process of mirror silvering, when in truth such is not the fact.

Legend Not Allowed As Trademark

IN a recent decision, First Assistant Commissioner Kinnan held that Chevy Chase Dairy, of Washington, D. C, is not entitled to register, under the Act of 1920, the notation "Safe Milk for Babies" as a trademark for milk, cream, buttermilk, cheese, and eggs.

The ground of the decision is that this legend or notation does not constitute a trademark as it does not indicate origin or ownership of the goods.

In his decision, after stating that applicant had already registered a composite trademark which included the legend in question, and now seeks to register the legend alone, he said:

"It is believed entirely obvious this legend does not function as a trademark but constitutes a mere laudatory statement as to the character of milk sold by the petitioner. When used upon milk the purchasing public would merely understand this legend to mean that the milk was safe as a food for infants. When used upon the other goods specified, the cheese, butter, eggs, et cetera, the legend would not be interpreted by purchasers to refer to the goods at all but to constitute a mere laudatory advertisement or statement that the petitioner also sold milk of this character."

Description of Function Not Registrable

IT has been held by First Assistant Commissioner Kinnan that the National Licorice Company of Brooklyn, New York is not entitled to register, under the act of 1905, the notation "Helps," as a trademark for licorice cough drops, since this notation is merely descriptive of the goods.

In his decision, after noting the argument that the mark was suggestive rather than descriptive, and pointing out why certain decisions cited in support of that contention were not conclusive of the question, and noting that registration had been refused of certain marks which were descriptive of a quality of the goods such as "Getwell" for a medicine, "Health Food" for a food product, No-D-Ka" for a tooth paste, he said:

"In view of the foregoing, it seems clear enough the notation here sought to be registered is descriptive of the function or effect of the use of the goods and is, therefore, merely descriptive."

Duplication of Words Voids Trademark

THE mark "White Cap" with or without a representation of ocean waves having white surfaces, is deceptively similar to the mark consisting of the words "White Cap" above a representation of a rounded cap such as is frequently worn by chefs.

Because of this similarity and the further holding that baking powder and self-rising flour are goods of the same descriptive properties, the Court of Customs and Patent Appeals has held that "White Cap" is not registrable for use on "plain and self-

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion, minimum number of words per insertion 24, maximum 60 Payment must accompany each insertion

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co, those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

AMPHIBIAN AIRPLANE—Having provision for alighting upon water, ice fields, level or otherwise, or desert sands, a stabilizing apparatus functioning in such manner as to retard the descent, in the event of an emergency. Patent 1765211. Frederico G. Diago.

PARACHUTE AND AERIAL LIFE BUOY—Whereby a bouyant body is provided using gas, and a smaller spread to the parachute presenting a floating structure when landing on water, and whereby a comparatively slow descent is secured. Patent 1765075. Edward G. Johnson.

Pertaining to Apparel

WATERPROOF OVERALLS—Which may be open at the front while sitting, but having a shield and drain so that water caught by the opening will pass off at a point exteriorly of the garment. Patent 1765096. Meyer Reingold.

RUBBER HEEL—Having an outer face formed of a plurality of ribs, and grooves spacing the ribs from each other with passages extending lengthwise through the ribs, the body being provided with sockets for securing the heel. Patent 1765155. Harry Heady.

GARMENT—Which may be readily placed upon an infant, secured in place, and conform to the body to allow free movement without binding, and which obviates the need of the ordinary rubber pants, which bind the legs. Patent 1765105. Bertha B. Skinner

Chemical Processes

PROCESS FOR PURIFYING PEARL ESSENCE—Which consists in bringing the pearl essence to a state of aqueous paste incorporating amyl acetate collodion containing from 8 to 14% nitrocellulose, liberating the water, and washing the product with clean ammoniacal water Patent 1760771 Jean Paisseau.

FERTILIZING SOLUTION FOR SEED TREATMENT—By treating the seeds with chemical agents so that the chemical action may in due time promote the growth of the plants or increase the quality or the quantity of product therefrom Patent 1762291. William F Gericke

Designs

DESIGN FOR AN ENSEMBLE SUIT—The inventor has been granted two patents, numbers 81394 and 81395. Dorothy Long.

DESIGN FOR A MIRROR STAND—Patent 81345 Frank N Mariani.

Electrical Devices

ELECTROMAGNETIC IGNITION DEVICE Adapted to light gas-nozzles, burners, stoves, or fuel mixed flames in general, is very compact comprising but three elements, namely a fixed core, a vibratory blade, a substantially fixed blade, and the usual magnatizing coil. Patent 1763113 Ruggero Righetto.

ELECTRIC TEA URN OR PERCULATOR—Comprising a water vessel, electrically heated, on top of which is a steam-tight vessel, having at its bottom a tea receptacle, and a pipe extending into the lower vessel, allowing steam to be passed through the tea. Patent 1762303. John A. McBride.

GENERATOR CIRCUIT PROTECTOR—Which will automatically shut the current from a generator to a resistance when the current is not being used for charging a battery, or when faulty connections exist between the generator and the battery. Patent 1762297. Elton R. Hopkins.

SHADE HOLDER FOR ELECTRIC LAMPS—A semicircular wire strand, for attachng a glass hood rising flour," in view of the prior registration of the similar mark for baking powder.

While there is no evidence that the two products have ever been manufactured by the same producer, the opinion states, still their relation to the art of cooking and their use in the production of bread and other food products is such that confusion is likely were similar marks for both registered.

"Suntan" Not a Trademark

THE notation "Suntan" for use on various articles of wearing apparel, including bathing suits, dresses, hosiery, caps, and so on, is not registrable as a trademark in the Patent Office, because descriptive of the goods, the Assistant Commissioner of Patents has ruled.

By extension of the meaning of the term the opinion states, "it now designates not only a color simulating that produced by the sun, but also the characteristic of wearing apparel which permits the direct action of the sun's rays upon portions of the body in order to produce a tanning effect."

Fictitious Names in Business

AN individual doing business under his own name and initials, followed by the word "company," is not required to comply with the provisions of the so-called fictitious name statute, since the name is not fictitious, the Supreme court of California has just ruled.

The statute, the opinion explains, provides that every person transacting business in this state under a fictitious name and every partnership transacting business in this state under a fictitious name or a designation not showing the names of the persons interested as partners in such business "must file with the clerk of the county a certificate stating the name and place of residence of the person or persons interested in the business "

Prior Disclaimer Nullifies Usage

THE disclaimer of any rights to the words "Liquid Solder" in an application for a trademark previously registered precludes a subsequent application to register these words as a trademark, where they have since the disclaimer been registered to another, even though their use by the applicant as a trademark was prior to their registration by the other party, the Court of Customs and Patent Appeals has ruled

The court overruled a decision of the Patent Office which had ruled that a disclaimer in a trademark proceeding may not be urged, by subsequent users of the mark disclaimed, as an estoppel.

Foreign News Reels Allowed in Italy

THE Italian government ban on the reproduction of foreign dialogue in sound pictures has recently been lifted to the extent of permitting the exhibition of news reels containing foreign dialogue, according to a report received in the Department of Commerce from Trade Commissioner Geroge R. Canty, Paris.

The following is a translation of the communique: "While the existing regulations forbidding the public showing of foreign dialogue pictures are still in force, the ministry of the interior has deemed opportune to concede the permission to show films containing talking sequences and dialogue in foreign languages when such films are taken from real life and reproduce: 'Actualities, ceremonies, sporting tournaments, military exercises, characteristic scenes or events, and so forth.' "

of the sectional type commonly employed for enclosing a portion or all of an electric bulb, adapting the same for use as a colored decorative light Patent 1765212. Jay J. Decker

Of Interest to Farmers

Chicken Roost—Which may be suspended from the roof or placed just above the floor, will be proof against lice or other insects, due to the fact that receptacles containing insect-exterminating liquid or powder, are suspended under the roosts. Patent 1760748. Henry Fintel.

Agricultural Machine Of the disc gang harrow type, whereby the disc blades of each gang may be set to a desired working position so that the soil broken by the leading gang will be further broken by the trailing blades. Patent 1760569. James S. Stewart.

Cotton Harvester—In the form of a vehicle adapted to be drawn over the rows of cotton plants with means incorporated for removing the cotton and discharging it into a body mounted on the vehicle frame. Patent 1762045. Arthur V. Benson.

Cotton Harvester—Adapted to be moved between rows of cotton plants, and having mechanism for removing cotton directly from the bolls of the plants and placing them in a predetermined manner in a container, ready for bailing. Patent 1763607. Julian E. Watkins

Cotton Harvester—Whereby the bolls and open cotton may be stripped from the stalks and the cotton which is left, together with the loose cotton, driven off and carried up by strong currents of air from the machine. Patent 1767979. Bedford Hestand

Rake Construction—Which not only facilitates the collection of matter by the rake, but functions effectively to clear its teeth or tines of matter adhering to or impaled thereon providing economy in labor. Patent 1768101. Erwin L Bell.

Of General Interest

Cigar Lighter—Having a simple and efficient means for throwing sparks from a block of pyrophoric alloy, to ignite a wick, will not readily get out of order, and may be easily assembled, adjusted or repaired. Patent 1762079. Charles Rubsamen.

Loud Speaker—A central cylindrical internally threaded casing, in which a single diaphragm mounted within the casing is adapted to propagate sound waves from a plurality of tone chambers. Patent 1762050. Charles G. Cook.

Sprinkler Head Which operates with a minimum quantity and pressure of water and in a manner to produce a maximum of slow and even distribution over a given area, particularly adapted for sprinkling lawns and gardens. Patent 1760903. Frederick Henkel.

Rotary Gate Valve -In which gates or shoes are mounted on a rotatable element so as to form a tight seal when the valve is closed, but when open a fluid may flow there through without obstruction or the formation of eddies. Patent 1760951. Richard G. Manifold.

Comb and Glove Therefor—A form-fitting cover of soft flexible material to be drawn over the teeth of the comb for dressing the hair, the attachment may be readily washed, kept free from dandruff and in a sanitary condition. Patent 1760928. Samuel W. Whitney.

Photometer and Exposure Control—The inventor has been granted two patents for the measurement of light to determine the proper length of exposure and manipulation of the camera shutter, in the art of photography. The one is an independent apparatus, the other is attached to the lens for automatically adjusting the diaphragm, and also includes means for finding the proper exposure time. Patents 1762047 and 1762048.

Truth in Sales Schemes

AN individual engaged in selling to retailers such services as sales promotion schemes, advertising data, and specialty merchandise, signed a stipulation with the Federal Trade Commission agreeing to discontinue a number of unfair trade practices.

To retailers he sold merchandise and plans of merchandising involving operation of a lottery. A retailer would buy from him a padlock, a large number of keys, and one of three pieces of merchandise; namely, a radio receiving set, a boy's auto, or a child's scooter, with which he received a supply of advertising hand bills, and window cards. The retailer would then give a key to each customer purchasing merchandise to a fixed minimum amount. When the keys were all distributed, the radio, auto, or scooter would be given as a prize to the customer holding the key that would unlock the padlock.

In selling his products he declared that he manufactured radios, when in truth the respondent did not represent a syndicate or association of advertisers and did not own, control or operate a mill wherein the merchandise he sold was manufactured

He advertised that certain of his products were offered for sale at factory cost when in fact all of his products were sold at a profit.

He shipped to merchants the instrumentalities and means of conducting a game of chance or lottery, with appropriate literature offering the gift or prize, and encouraged and enabled retail merchants by means of advertising literature to represent that they were selling merchandise at factory cost, when in fact it was sold at a profit.

Motor Bus Accidents Decrease

ONE motor bus passenger in every 1,250,000 passengers carried on buses in Ohio was killed during the last year, it was stated by the chairman of the public utilities commission, Frank W. Geiger, in noting marked improvement in the manner of operating buses since the commission issued a safety order some months ago.

During the year, the chairman said, motor buses carried 32,375,531 passengers, and of these 26 lost their lives in accidents. In this time, he stated, 1032 cars traveled a total of 56,224,254 miles.

Color in Rope Trademarks

THE Assistant Commissioner of Patents has ruled that a trademark for wire rope, consisting of a silver strand which is incorporated in the rope during its manufacture, is registrable in the Patent Office, even though the opposer has a registered trademark for a similar rope consisting of the use of a red strand in the rope.

The Assistant Commissioner found that there would be no confusing similarity between the products as marked by the two different colored strands.

Flat Asbestos-Cement Roof and Wall Sheet—Constructed to be applied directly to a vertical supporting frame member of a building without sheeting or horizontal supports and without overlapping, is not too flexible or brittle, and will form good insulation against heat and cold. Patent 1763469 Louis Lane.

Dispensing Container—For holding sugar, salt, pepper or the like, is sealed against the entrance of moisture, dust or insects, by the mere act of being placed upon a support, the upper end being completely closed. Patent 1763449. Henry T. Trautvetter.

Folding Chair—Having a canopy readily foldable with the chair, the construction is such that it may be readily set up for use, and easily folded to occupy little space for storage Patent 1763455. Emil de Bruijn.

Pipe Insulation—Which may be mechanically constructed in sections, at little cost, and applied to refrigerating pipes and the like, has novel means for sealing the various sections, making the connections both weather and air-tight. Patent 1762276. George J. Schreier.

Attachment for Collapsible Tubes—In the form of a discharge nozzle which may be bent with the fingers without closing the passage to provide a terminal at an angle to a tube, to be used as an eye dropper or the like. Patent 1765114. George S. Turner.

Box—Which may be cut from a single pasteboard blank and shaped to be readily folded into a rectangular box structure having a retaining locking extension and an ornamental upstanding projection on top for receiving decorations Patent 1765084. Edwin A. Locke, Jr.

Pin Hinge—For an ornament, wherein the hinge is molded on the ornament body as the molten metal cools, the mold parts being readily separable for the removal of the ornament. Patent 1765131. Israel W. Cooper.

Acoustic Device—More particularly a sound generator for radio loud speakers, comprising a diaphragm made in the form of a frustrum of a hollow cone, the sound reproducing apparatus being connected to the smaller aperture of the cone. Patent 1765121. Max P. Bonnat.

Cover Holder—For retaining the lid of a cooking vessel, kettle or like receptacle, in position and for preventing unintentional displacement while canting the vessel for the purpose of drawing off liquid. Patent 1765135. Eben G. Doland

Steam-Pressure Cooker Which is made of aluminum, with handles formed on opposite sides, with arms and spaced ears extending upwardly, which resiliently clamp the edge of the lid to withstand the steam-pressure. Patent 1765072. Takichi Hashimoto.

Container Head—Constructed of composition material covered with a layer of sheet metal, or fiber, which will provide an effective substitute for a solid wood or all-metal head, and comprises a complete unit. Patent 1761389 Herbert L. and James N. Carpenter.

Balanced Three-Way Valve—A self-closing valve wherein the outlet ports are so formed as to present a maximum opening, while preventing any parts being interfered with, may be used for many purposes where short admission of fluid pressure is desired. Patent 1765090. George G. Morin.

Closure for Toothpaste Tubes—Formed with a rotating closure plate capable of being moved to an open position by the thumb, and moved to a closed position by spring pressure, the structure coacting with a resilient lock. Patent 1765128. Claude A. Conover.

Tally Card—Especially designed for use in connection with card games, such as bridge-whist, in which the players are arranged at a number of tables for progressive play, the tally simultanously indicating the games played. Patent 1768020. Joseph J. Arnold.

Conical Grater—Having a removable grating chamber which is provided with a plurality of radially extending barriers adapted to retain the material to be grated against the grating surface. Patent 1768076 John W and Arthur E Klensch.

Clip—Known in the trade as a "money clip" for clamping bills of different denominations and which will permit the ready removal of a single bill from the stack without disturbing the other bills. Patent 1767973. Stanley L Gedney.

Binder—Which is strong and durable and adapted to support a book or books or other objects for pivotal mounting in connection with a bookstand, and having means for locking the parts in operative position Patent 1767978 Walter E Haskin

Envelope Sealer—Wherein means are presented for easily receiving and guiding the envelope and its flap so that the flaps will first be moistened and then pressed to a sealed position, the device may be applied to a wall or support Patent 1767908 Benjamin Zuckerman.

Atomizer In the form of a doll having one or more movable appendages, such as the arms or legs constituting parts of the doll, which may be manipulated to cause atomization of the perfume or other liquid used Patent 1767911 Benjamin Berko and Joseph Brewer

Pipe—A tobacco pipe, which may be constructed from a wide range of materials, and so formed that the various parts may be readily aired, cleaned and kept in a sweet condition. Patent 1767997 Robert W Nicholls

Combined Seat and Carrier A combined portable carrying case and seat, which is of simple construction and particularly adapted for outings or picnics for transporting luncheons and various articles for use on the trip Patent 1767925. Thomas Hargreave

Envelope—A remailing envelope of the single pocket type formed of two sheets of paper with flaps disposed in opposite directions, the envelope being adapted to be folded upon itself when remailed as first class matter. Patent 1768161. Nathan Sternheimer.

Container—Having a hinged closure, and a resiliently raised article holder, which when opened will dispose articles such as cigarettes and matches, etc, to a position where they may be readily grasped. Patent 1768061 George O Holben.

Attachment for Pencils—Which may be used for scraping, cutting or clipping bills of lading from packages and the like, the device may constitute a part of the main chamber or be used merely as an attachment for mechanical pencils. Patent 1767918. John C Taylor

Oarlock—Constructed of a minimum number of parts, so that on the pull stroke, roller bearings will engage one side, and on a push stroke the other side, the oar lock may be converted for sculling a boat Patent 1768006 Arin G and Harold M. Seberg

Atomizer—By which the heavier hydrocarbons can be reduced to such a fine degree of atomization as to produce substantially perfect combustion, greatly facilitating the cracking in distillation of petroleum Patent 1764107 Oscar Kay

Bullet Mold For casting hollow-point or solid point bullets as desired, the hollow point is automatically withdrawn when the mold is opened, the bullet readily dropping from the mold after casting. Patent 1763977. Marion G. McNeely.

Panel Construction—In the form of a removable panel construction, comprising a plurality of frames having panel receiving recesses for tile, marble, plate glass mirrors, which will eliminate waste of labor in assembling and installation. Patent 1763966. Louis Hoffman

Gift-Dispensing Apparatus—Comprising a board in representation of a rainbow having chutes thereon for dispensing gifts to children, in a manner to carry out the mythical belief that at the end of the rainbow is a pot of gold. Patent 1763733. Alice C Westgate.

Angle Trisector Having a semi-circular shaped member, a radially-extending arm projecting therefrom, and a curved arm having its ends secured to the semi-circular member, for giving the proper point location for an angle between zero and 180 degrees Patent 1764581. Sojiro F. Shibuya

Display Rack and Stand Having novel means for supporting a plurality of racks or casings so that they may be moved in a circuitous path with respect to their supporting member and with respect to each other Patent 1767980 Raymond S Hintzee.

Hardware and Tools

Saw Table A movable frame for supporting a circular saw in substantially a horizontal plane, manual means being employed for moving the frame and saw, and its operating means, longitudinally of the table Patent 1763478. Clarence E Palmeter

Window Fastener Comprising a corrugated fastening strip secured to the frame and a hinged fastener with tension spring, for locking the window in any position against upward movement but allowing a downward movement at will. Patent 1762280. Arthur J. Slingerland.

Dado Cutter A device of simple construction for cutting grooves, whereby a plurality of grooves may be formed of various dimensions through adjustable means for controlling the position of the cutters. Patent 1763163. John Garthe

Combination Cleaver, Knife and Saw—Comprising a blade, the major portion of which forms a knife, the remainder being thickened to form a clever-like structure, the construction being such that the back of the blade will support a saw. Patent 1763152. Bert Williamson.

Ice Pick—A pick or awl-like member which may be safely disposed within the handle, when not in use, but may be readily projected and held in active position for breaking ice. Patent 1768035. William E. Domaratius

Sharpening Device for Curved-Edged Tools A manually operable sharpening tool for traversing and conforming to the swing of the curved cutting edge, making it possible to sweep the cutting edge at one stroke and at the proper angle Patent 1767911. Norris T Pindar

Heating and Lighting

Revolving Broiler Wherein different kinds of food to be cooked are carried by suitable supports, and caused to rotate while exposed to view, but remain unmolested until completely cooked, yet may be basted from time to time. Patent 1762035. George Soylian

Apparatus for Utilizing Solar Heat—Which includes a chamber adapted to be exposed to the sun rays' and in which the sun's heat is concentrated, a steam generator into which heated gas is introduced under pressure for utilization. Patent 1765136. Charles H Drane.

Cold-Water Tube and Cleaner for Domestic Boilers and Heaters—Wherein a clean-cut tube is provided which may be used by workmen for cleaning out a boiler or heater or may be used as a combined cleaner and cold water supply pipe The inventor has been granted two patents of a similar nature Patents 1767919 and 1768039. William Eiermann

Machines and Mechanical Devices

Lubricant-Distributing Apparatus—By which the various movable parts of an engine or other mechanism, can be automatically lubricated, the feeding being increased or decreased according to the speed of the engine and excess lubrication prevented. Patent 1760902. David Grattan

Beater—Which utilizes an electric motor and a form of planetary gearing whereby the beaters or stirring members may be grouped so that certain members will move in a circle and others will rotate in situ Patent 1762081. George Schleicher.

Apparatus for Liquefying Solidified Honey—Whereby the liquefaction of solidified honey in cans, may be effected in order that the honey may be removed, without discoloration, thus maintaining its original market value. Patent 1761479. Aleck G Kuykendall.

Load-Ejecting Apparatus for Conveyers Such as dredgers, excavators, loaders and trenchers, having buckets or scoops in which loads of material are adapted to be transported and the material completely and automatically ejected therefrom with the utmost ease. Patent 1760961. Harold M Ruth

Speed-Changing Mechanism—Whereby a speed changing device is provided which gives four direct running speeds with three pairs of gears only, the transmission gears serving not only as idlers but themselves contributing to speed reduction. Patent 1762080. Charles Schaefer

Hydraulic Actuating Mechanism—Whereby positive control of the valves is maintained, and the position of the valves, is totally independent of the particular construction of the engine, as the usual valve working rods, levers, and cams are completely dispensed with Patent 1762068 Heinrich M. M. Mattern, Jr.

Fishing Tool—For removing from wells broken or lost parts of rotary bits, or other tools used in rotary drilling, in such manner that by removal of the drill pipe the obstructing object may be recovered. Patent 1761463. Govenor K Beckett.

Well-Casing Shoe—For use in the sinking of outer or inner casings or screens, to afford means for introducing water under pressure to the lower edge of the shoe for eroding the formation through which the casing is being sunk. Patent 1762012 Elmer D Every.

Combined Drying, Drumming, Cleaning, Caging and Finishing Fur Machine—Capable of effectively performing all the necessary steps to condition fur-skins or pelts for commercial purposes, incidentally accomplishing these results with comparative economy as to time, labor, and expense. Patent 1763462. Herman Gabbe.

Plaited Hat Lining and Method and Apparatus for Making the Same A sewing machine with an attachment for plaiting hat linings in which a stiffening filler piece is employed to connect the side, crown and tip of the lining to give a highly tailored effect Patent 1763468. Alfred Kurtz.

Road-Working Apparatus—Preferably in the form of a power operated vehicle having electromagnetic means adjustably mounted thereon, and to be transported along a road for picking up all ferrous materials or substances injurious to pneumatic tires. Patent 1763457. Charles R. Churchill and Joseph R. Haynen.

Fortilla-Forming Machine—A cake forming machine embodying a pair of coacting dough pressing rollers having means for detaching the dough from one roller and subsequently detaching the cut or stamped cakes from the other roller Patent 1763445. Luis Romero.

Drawing-in-Filling Preventer For preventing the catching of the remaining filling on a bobbin between the shuttle and box plate of the loom, and the breaking off at a moment of transfer of a new bobbin from the magazine. Patent 1763456. Theophile Caux

Spray Gun—Which has novel means for actuating the air valve and paint valve simultaneously, whereby there will be no frictional contact, and means whereby the spray may be changed from a round to a flat. Patent 1762282. Emil H. Stephan.

Automatic Sash Machine—For use in the manufacture of window stiles, wherein means are provided for feeding the stiles to the machine, boring, grooving, molding the stock on two edges, and dressing to a desired thickness, in a series of operations. Patent 1762273. David B Mackenzie.

Power Steam-Feed Lever For operating the steam feed valve in a saw mill by mechanical power, which will eliminate fatigue on the part of the operator in using the hand-operated devices usually employed Patent 1765069. Edwin J. Gibson.

Pump—Primarily designed for oil wells in which one or more controlling pistons are positively manipulated from above the surface of the ground, either hydraulically, mechanically, electrically, or by air or gas pressure. Patent 1765085. Harley H Markey.

Semiautomatic Dipper Trip and Monkey-Line Winder—A re-winding mechansim for monkey lines, wherein the line may be maintained taut, taken in and allowed to slacken as desired, for maintaining a clam shell bucket in a swinging or desired position. Patent 1765089 George G. Morin.

Ship-Unloading Device Whereby means are provided for quickly conveying merchandise from the hold to the deck, and by a chute directly from the deck to the quay or lighters, without encumbering either the hold or the deck. Patent 1765118. Mario Abriani.

Dispensing Device—Which is adapted to dispose in bottles predetermined amounts of liquid with means for varying the amount disposed, the operation continuing until the entire amount of liquid in the machine has been disposed of. Patent 1763971. James Kantor and Charles H Miller.

Submarine - Salvaging Apparatus — A suitable number of floats carried by a submarine are released by the sunken boat, whereby a salvaging crew, with the aid of a mother ship, may raise the submarine without requiring divers to be sent down Patent 1765101. John Schierenbeck.

Lawn Mower—Particularly adapted for cutting grass located adjacent to the trunks of trees or close to fences, walks, bushes or other parts adjacent to a lawn which have been inaccessible by the conventional type of mower. Patent 1762287 John H Blair.

Vending Machine—Adapted more particularly for vending flat articles, such as newspapers, periodicals, etc., a slidable drawer permitting the delivery of the article after a required number of coins have been deposited Patent 1765216. Major Duncan.

Boiler Flue and Pipe Cutter—In which a circular knife is moved into contact with a revolving pipe to be cut, a motor causing operation of rotating means, revolving means being manually actuated for causing the cutter to engage the pipe. Patent 1765208. James I. Cunningham.

Sheet-Cutting Machine—A rotatable work support and conveyer for moving rubber sheet material in a longitudinal direction for cutting sheets at predetermined points as the rubber is fed from he calendar. Patent 1765184. Elno H. Trump.

Bottle Washing Machine—In which the bottles are inverted and successively fed over jets of fluid containing solid objects such as rubber spheres, which are projected for removing foreign matter both from the interior and exterior of the bottle. Patent 1761492. Frank B Reily

Bit-Forming Machine—With which uniform shaped bits of comparatively superior construction may be produced expeditiously and for sharpening used bits of uniform shape, may be adjusted to different sizes. Patent 1767881. Jeremiah V. Gustin.

Pump—A rotary high speed submerged verticle type; the blades of the water wheel being constructed to obtain a greater lift in proportion to the horse power required, especially useful for irrigation purposes. Patent 1768130. Robert L. Meaux.

Lock Designed to be gravitationally locked and electrically released although intended to broadly cover mechanical releasing means, particularly adapted for sliding closures, such as cages in banks, is simple and highly efficient. Patent 1768021 William E Bauerband.

Multiple-Speed Transmission Mechanism—Which includes a shiftable carrier composed of sections which are sleeved on the drive and driven shafts, whereby various combinations of gearing and different speeds will be effected Patent 1767909 Herbert G. Altvater.

Watch-Crystal-Fitting Device—Whereby the pattern and size of crystal may be readily and accurately traced on a crystal blank directly from the inside edge of the bezel of the watch case to which the finished crystal is to be applied Patent 1767935. James B McDaniel

Cutting and Grinding Mill—For feed, silage, etc., having a stationary cutting knife at the entrance of the machine in connection with the rotary cutters, whereby the material will be cut into pieces before grinding so that no choking of the machine will occur. Patent 1767921 Steve R Gately.

Machine for Cleaning Cotton and the Like—Which continuously utilizes the same current of air, so that the moisture content may be relied upon as being substantially uniform, and the change of air at short intervals obviated. Patent 1767957. John S. Bachman.

Floor Polisher A unitary structure which may be readily applied to the floor and easily operated with means for adjusting the horizontal position of the brushes. Patent 1767983. William H. Hughes.

Closure-Operating Mechanism—By which doors, particularly garage doors, are adapted to be automatically opened or closed according to the vehicle approaching or leaving the garage, thus obviating annoyance in inclement weather. Patent 1764150. George G. Candee.

Apparatus for Automatically Determining and Recording the Specific Gravities of Fluids—For use in measuring gases, natural or artificial, flowing through pipes, where due to the mixture of different densities, it is desired to have a record of the specific gravity at all times. Patent 1764103. Harry A. Hurley and Herbert J Tones

Street-Marking Apparatus—Having one or more brushes, each rotatable about a vertical axis, in a manner to produce a painting motion for marking highways with lines for defining pedestrian and vehicular traffic zones. Patent 1764546. William B. Burnley.

Medical and Surgical Devices

Womb Medical Applicator—Comprising a ring of semi-flexible material, and a receiving bag associated therewith, with inwardly extending loops adapted to receive and apply a medicament to the cervix and associated portions of the female anatomy. Patent 1760751. Jose L. M. Guenard.

Test-Tube Rack—Composed of several parts which can be nested and conveniently carried from place to place in a satchel and set up for supporting the tubes during the heating and cooling action, and the draining and drying. Patent 1763161. Charles Fowler

Musical Devices

Music-Teaching Device—Having a staff board and a number of lights representing notes on the scale, the lights being controllable by the teacher, whereby the students will quickly learn to sing at sight from the illuminated notes. Patent 1763441. Michael B. Rock.

Musical Instrument—Especially designed for use in children's bands, as a foundation for other instrumental work, it being constructed to start the coordination of the tongue, lipping and fingers, as used in wood wind instruments Patent 1767998. William B Parkinson

Plumbing and Fittings

Plumbing Fixture—A pressure trap, having in combination therewith a pivoted buoyant valve member adapted to control the flow of fluid therethrough in a predetermined direction, the whole forming a simply assembled and disassembled fixture. Patent 1763466. Albert M Khun.

Plumbing Fixture—A back pressure trap with leverage means for controlling the movement of an associated valve whereby the flow of fluid is confined to a predetermined direction and back pressure is prevented. Patent 1765078 Albert M Khun.

Prime Movers and Their Accessories

Valve Mechanism for Internal-Combustion Engines—A valve in the form of a vertically positioned sleeve mounted to turn in a circular groove in the head of the engine, and held in place by a top plate, annular gear teeth imparting the turning movement. Patent 1763460. Jesse F. Fisk.

Reversing Gear for Reciprocating Engines with Hydraulically-Operated Valves Whereby reversing is effected by altering the admission and discharge of the fluid to and from the pistons, by means of cocks or other control devices in the corresponding pipes for the liquid. Patent 1763471. H. M. Meier Mattern.

Valve Lifter—Adapted to be operated in conjunction with spring-actuated poppet valve members of an internal combustion engine, affording a positive vertical lift, simplicity in operation, extreme power, and insuring a positive lock at any height of lift. Patent 1765138. Willard J. Dunston.

Valve—Having novel means for directing the exhaust gas away from the valve head in an internal combustion engine, preventing the warping and leaking of the valve and keeping the valve head cool. Patent 1763951. Carl F. Burgmann.

Engine—Of the two-cycle principle, in which the customary piston is inverted and the explosion of the gas takes place within the interior of the piston, a novel water jacket cooling the inside and outside. Patent 1763959. Fred F. Finch.

Valve-Spring-Lifting Tool—For compressing the coil spring around the stem of a poppet valve of internal combustion engine to release the tension upon its supporting pin so that the pin may be withdrawn and the valve removed. Patent 1761519. Arthur L Mettler

Railways and Their Accessories

Rail Fastening Including a fastener plate formed substantially H-shaped and having overhanging shoulders with the parts formed to be secured to ties by spikes welding, rivets or other securing means Patent 1760723. John G and Arthur N Snyder

Dirigible Headlight—For locomotives, or the like, having a support responsive to gravity to cause the light to automatically illuminate the track in advance of the locomotive, whether the latter is traversing a curved or straight stretch. Patent 1761484. George G. McNee.

Flange Oiler For oiling locomotive wheels whereby the lubricant may be directed against the flange of the wheel which is brought into direct contact with the sides of the treads of the rails. Patent 1765202. James C Burford

Air-Actuated Mechanism for Locking Throttle Levers—Wherein the air employed for positively locking the throttle lever may be passed to a bell-actuating mechanism for notifying persons upon the train or there around that the train is to be set in motion Patent 1763951. William M Cross

Combined Tie Plate and Rail Anchor—Which will rigidly hold the rail against lateral or longitudinal displacement, obviates the need of the ordinary tie plate and protects the tie, and acts as a brace for the rail Patent 1767937. William A McFarland.

Signal Recorder A recording mechanism for each actuation of a signal which embodies a horological instrument and a pressure actuated time stamping mechanism operable incident to the action of the signal, or the actuation of a whistle on the locomotive Patent 1768151. Harry O Sampson

Pertaining to Recreation

Toy Palpitating Heart—A toy of novel construction which may be used to simulate the action of a palpitating heart, for the purpose of surprising and amusing onlookers. Patent 1763167. Herman H. D Klinker

Swimming Device—By means of which persons not experienced in the art of swimming are able to keep afloat on the surface, to increase the efficiency of the stroke, and thereby reduce the muscular force exerted in swimming Patent 1765116. Linwood R. Williams.

Game Board—Of the type in which objects moving about the surface of the board are controlled by a player, the board having a resilient mounting, may be readily tilted to various angles and inclinations. Patent 1768016. Arthur L. Walker.

Ski Sled—Which may be used as a sled and the runners thereof being in the form of skis, may be readily detached for use in the usual manner for sliding over freshly fallen snow. Patent 1768016 Christian Fredrickson

Pertaining to Vehicles

Vehicle—A pedal-operated device whereby smooth operation will be insured during all the various stages, and having means whereby the vehicle may turn a corner at a high rate of speed, with a minimum risk of overturning. Patent 1758957. Robert G. McKay.

Parking Device for Motor Vehicles—A simple attachment which may be used with a standard automobile, whereby the front wheels may be lifted and the rear end wheels swung about as a pivot, until a curbing, or the like is paralleled. Patent 1758964 John Myers.

Rumble-Seat Top Which is incorporated in the car body during manufacture and completely housed in the seat structure when not in use, but readily capable of extension to completely house the occupants when required Patent 1760331. Otto Altenbach.

Motor Vehicle Seat Particularly adapted for use in connection with the driver's seat, whereby the seat is so constructed that it may be adjusted to alter the vertical height to that most comfortable for the driver's personal use. Patent 1762016. Albert B Blumenberg.

Lining-Gun Nozzle—Comprising a tapered tubular intake stem and a form of hair-brush or pencil, designed to be drawn along a moulding or the plain surface of a motor car, a drip container catching any surplus liquid. Patent 1762058. Herbert H Harris and William T Whittingslowe.

Steering Gear—In which the engine or motor is utilized to shift the angular disposition of the wheel, it being only necessary for the operator to initiate the movement Particularly adapted for heavy vehicles requiring great strength. Patent 1763170 George E Lemon.

Signal Mechanism for Automobiles—For automatically lighting the lamps at the front and rear to indicate turns, the mechanism being manually actuated, and independently functioning for lighting the lamps in different sequence, to indicate the turning motion. Patent 1763165. William F Hild.

Device for Supporting Articles on Tires or the Like—For supporting, for instance, a mirror, on the spare tire, commonly carried on the running board, of an automobile, in such position that it may be conveniently observed by the driver, but secured against theft. Patent 1765099. Abraham W Rosen.

Motor-Vehicle Brake—Wherein the brake band has one end fixed and its other end movable so that upon application of operating pressure the entire band will be circumferentially expanded against the brake drum. Patent 1768176. Gus Walker.

Recording Device for Automobiles—Which may be secured to the instrument board of a car, and swung from behind the latter into position for quickly recording various data relating to gasoline filling, oil, etc. Patent 1767921. Nelson L. Greene.

Signal Device for Motor Vehicles—An arm type of signal, for extension outwardly from the side of the vehicle to indicate to the drivers of other vehicles the stopping, slowing, or direction of turn, the device is manually controlled. Patent 1768031. John Deblieux.

Card Holder—Whereby a certificate or owner's registration card or the like, may be securely fastened in a conspicuous place on a part of the automobile, and means for preventing substitution of another card. Patent 1767993. Adolph G Lorenz.

Theft-proof Tire-Valve Cap—A simple device which will be under control of an authorized person to make possible the application or removal of the valve stem cap, but impossible for unauthorized persons to remove the cap. Patent 1767881. Harison Heinrich.

Air-Pressure Gauge A gauge for use in connection with an attachment employed for inflating tires, the device is of simple construction and arranged to permit the gagging and indicating of various pressures. Patent 1768275 William C. Urton.

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MAKE	MODEL	Front Wheels	Rear Wheels	Pinion	[illegible]	[illegible]
Auburn	All	x	x	x		x
Austin		x	x			x
Cadillac	All				x	x
Chrysler	66 70 77	x	x	x		x
	Imperial	x				x
Cord	All	x	x		x	x
Cunningham	All	x	x	x		x
De Soto	6	x	x	x		x
	8	x	x	x	x	x
Dodge	6	x	x	x		x
	8	x	x	x	x	x
DuPont		x	x	x		x
Durant	614	x	x	x	x	x
	617	x	x	x	x	x
Elcar	75	x	x	x		x
	95, 96 130	x	x			x
Essex	All	x	x	x		x
Ford	All	x		x	x	x
Franklin	All	x	x	x	x	x
Gardner	All	x	x	x		x
Graham	Standard Six	x	x	x	x	x
	Special Six	x	x			x
	Eights	x	x		x	x
Hudson	All	x	x	x		x
Hupmobile	S & C	x	x	x	x	x
	H & U	x	x	x		x

MAKE	MODEL	Front Wheels	Rear Wheels	Pinion	[illegible]	[illegible]
Jordan	All	x	x	x		x
Kissel	73 & 95	x	x	x		x
	126	x	x	x	x	x
Kleiber	All	x	x	x		x
La Salle	All					x
Lincoln	All	x	x	x	x	x
Locomobile	86 & 88	x	x			x
Marmon	69	x				x
	79 & 8	x	x			x
McFarlan	All	x	x	x		
Moon	All	x	x	x		x
Nash	Std 6	x	x	x	x	x
Overland	8	x	x	x	x	
——	All	x	x		x	x
Peerless	B & C	x	x			x
	A	x				x
Pierce Arrow	All	x	x	x	x	x
Plymouth	All	x	x	x		x
Reo Flying Cloud	20 & 25		x		x	x
	15	x	x			x
Roosevelt	All	x	x	x		x
Studebaker	All	x	x	x	x	x
Stutz	All	x	x	x		x
Whippet	All	x	x	x	x	x
Willys Knight	All	x		x	x	x
Windsor	All	x	x	x		x

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ASTRONOMICAL NUMBER

Signaling to Mars—Amateur Astronomers' Activities

SCIENTIFIC AMERICAN

October 1930

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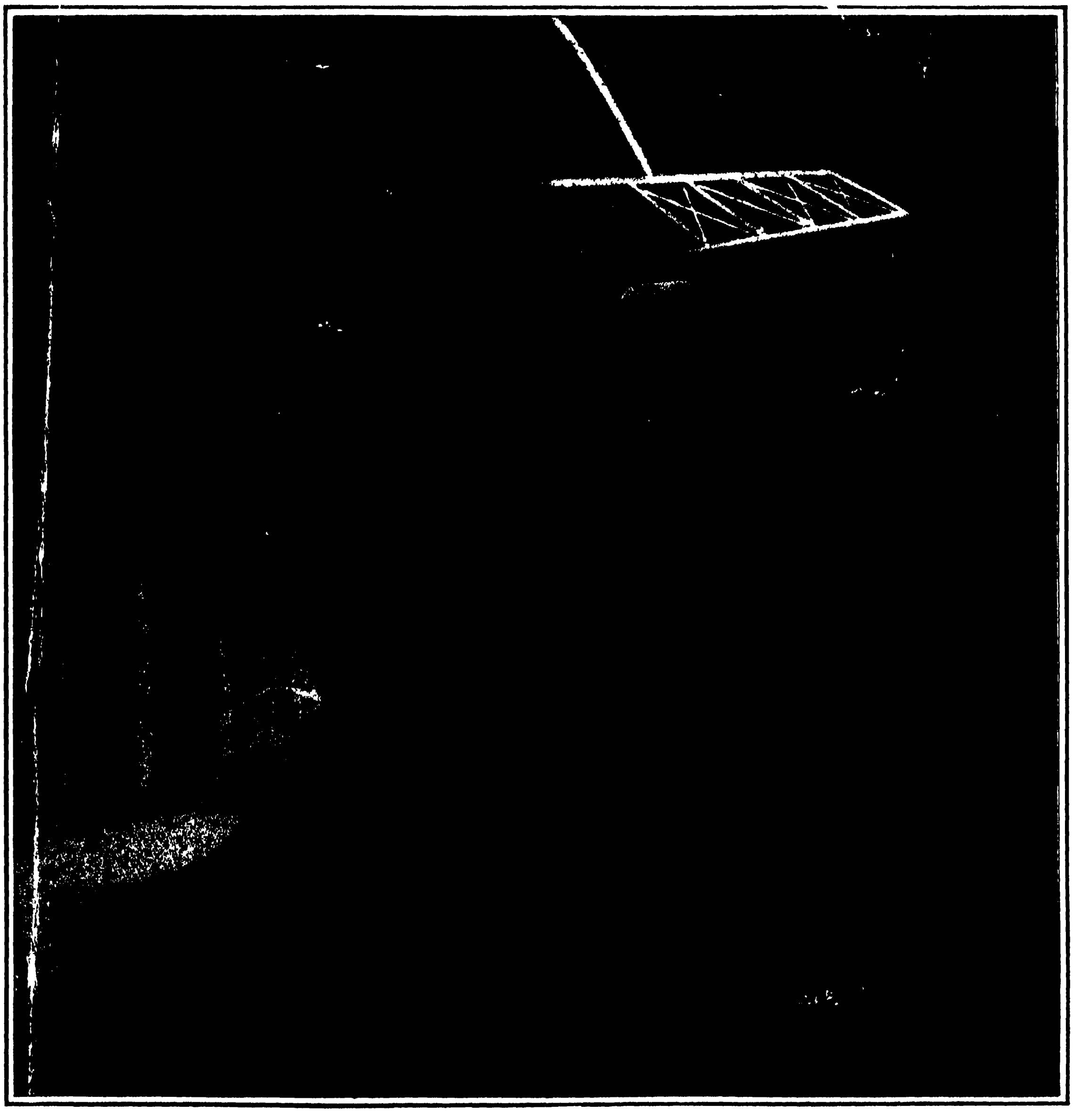

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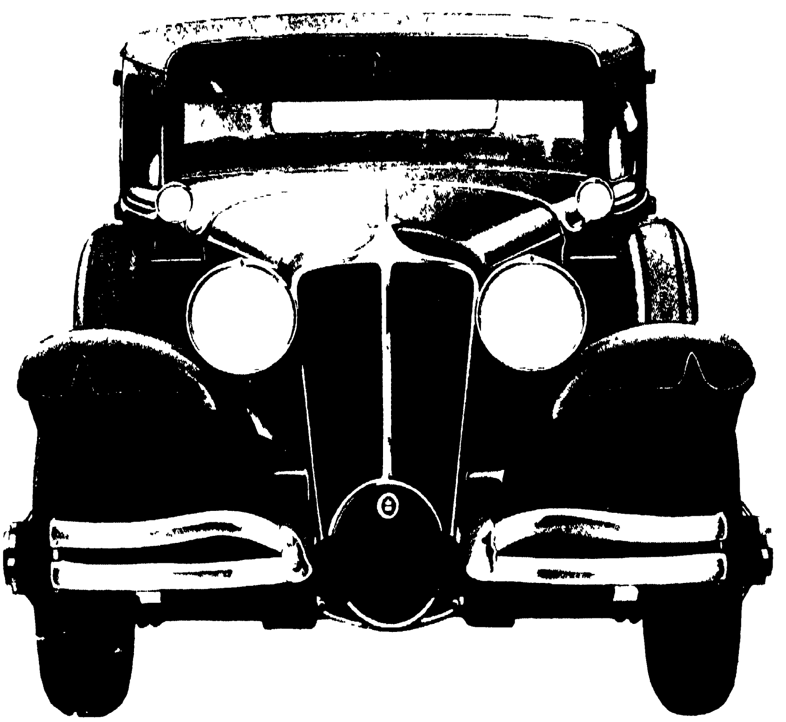

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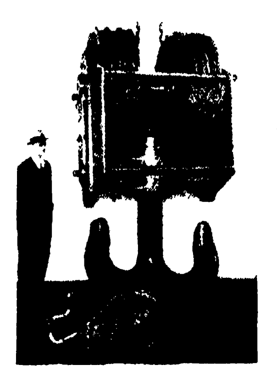

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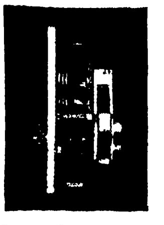

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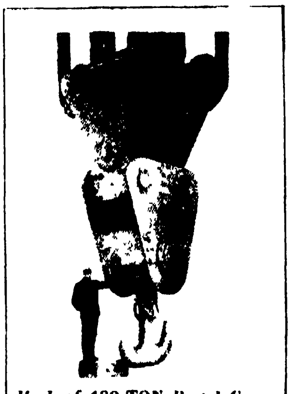

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Across the Editor's Desk

NEW cover design . . . new style for title on cover . . . new cover painting size . . . new contents page layout . . . new typography throughout . . . new layouts for articles . . . new and better paper stock . . . better reproduction . . . better printing . . . better engraving . . . new and more pleasing in appearance from cover to cover. Thus may be described the November issue of the SCIENTIFIC AMERICAN.

It has been said truly that all progress is change. The SCIENTIFIC AMERICAN, bringing to its readers the news of progress in the scientific world, has always endeavored to set the pace. Therefore, when we decided three months ago to change our entire format to keep in the forefront of the publishing field, we called a conference of experts in various phases of the business. Cover designs were made and rejected until one was found which we felt to be most suitable for our SCIENTIFIC AMERICAN. Typography was studied from all angles and a type family was selected that is at once dignified, readable, and flexible enough to afford variety. Sample layouts for articles were worked over by our make-up editor and he promises us that forthcoming issues will present a better and more up-to-date appearance than ever before.

But with all these changes in the mechanical make-up of the magazine, our editorial policy will remain unchanged. We will, of course, continue our endeavor to obtain for you each month the very best articles on every branch of science, and to prove our point we will proceed to outline in brief a few of the feature articles scheduled for early release.

The November issue will be our annual Industrial Number, and prominent among the articles will be one dealing with the hydrogenation of oil and coal. Heralded widely in the daily press, this process promises to be revolutionary in the oil industry. By means of it, it is possible to treat crude oil with hydrogen so that 100 gallons of gasoline can be produced from 100 gallons of crude. Sounds almost impossible, doesn't it? But we learn from the article that the Standard Oil Company is erecting three plants for this work, and that the process has proved entirely practicable.

There are many rumors abroad in the land regarding the future of television, and to clear up some of the misconceptions on the subject, we are going to publish an article by a prominent English radio authority in which is pointed out the fact that television is greatly in need of new ideas and less ballyhoo. We believe that this is one of the first clear-headed, unbiased surveys of the entire television field as it is today, that has ever been published.

Occasional cool mornings about this time of the year bring to mind the fact that the football season is not far off. Timely, then, is an article on hand which reveals the surprising fact that when you pay five dollars for a ticket to a football game, you actually pay at the rate of $24.25 an hour to watch this thrilling sport. This seeming anomaly is explained by the fact that, in the average game, the ball is in actual play for less than 12 minutes! An expert in industrial time studies has made a critical and accurate survey of a series of games between famous teams and gives his results and conclusions in an article that is both interesting and informative.

The electrification of railroads is a subject that is of vast importance to industry in general. The average person, however, whether he be an investor in railroad stocks or interested in the subject for its own sake, is often misled in his search for information by conflicting published statements. We have therefore obtained, from an authority in the field, an article that tells dispassionately and without bias, the whole truth on the proposition and what it all means to the general public.

Other articles that will appear will cover such subjects as how industrial wastes are reclaimed, the story of cork, radio weather vanes ten miles high, seismology, "slotted wings" of birds, how sugar is made, and others. We hope that when the November issue reaches your hands you will enjoy it as much as we have enjoyed working on it and selecting its new style.

»**BEYOND COMPARISON**—*William Beebe*

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»Will long REMAIN UNCHALLENGED—*President Angell of Yale*

»So vivid and easy...so alive...it HOLDS A CHILD'S INTEREST —*Mrs. Franklin D. Roosevelt*

»ITS EQUAL DOES NOT EXIST—*New York Times*

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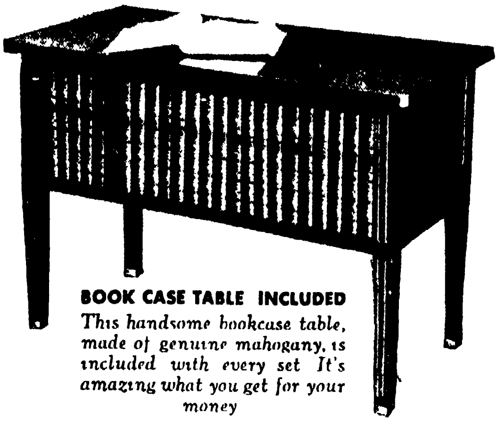

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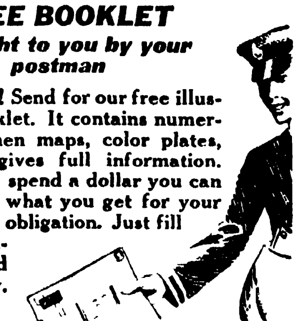

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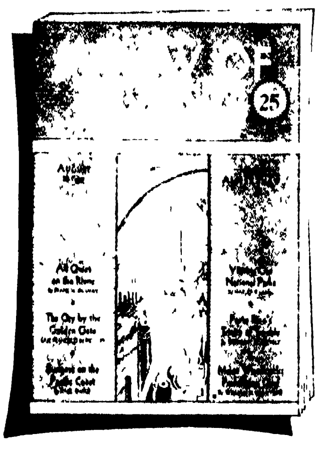

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SCIENTIFIC AMERICAN

October, 1930 *ORSON D. MUNN, Editor* *Eighty-sixth Year*

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COVER

A member of our staff asked Russell W Porter, who was returning east from his season's work at the California Institute of Technology, what the new 200-inch telescope would look like. Mr Porter's answer was given with a pencil. Later his sketch was followed by Howard V. Brown, our cover artist. This is the fork type of mounting tentatively adopted for the model built by the Warner and Swazey Company The telescope shown will weigh 750 tons.

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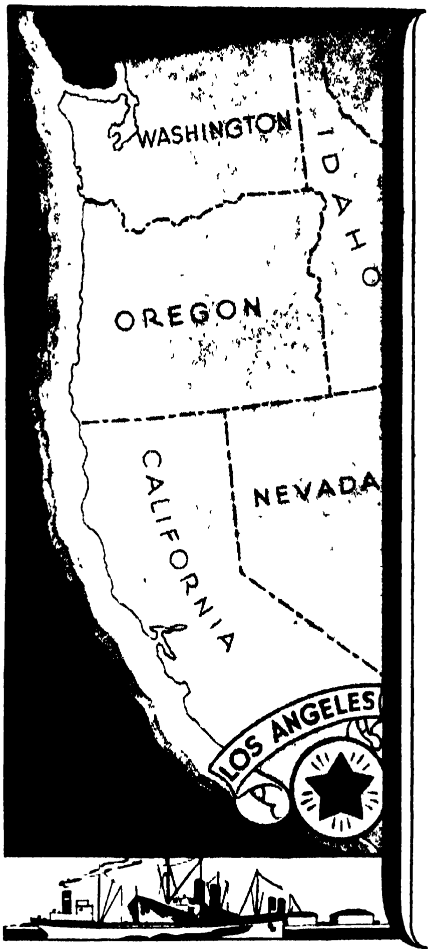

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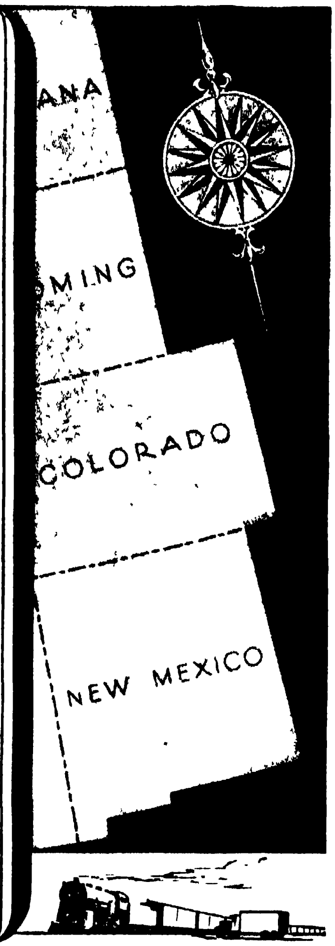

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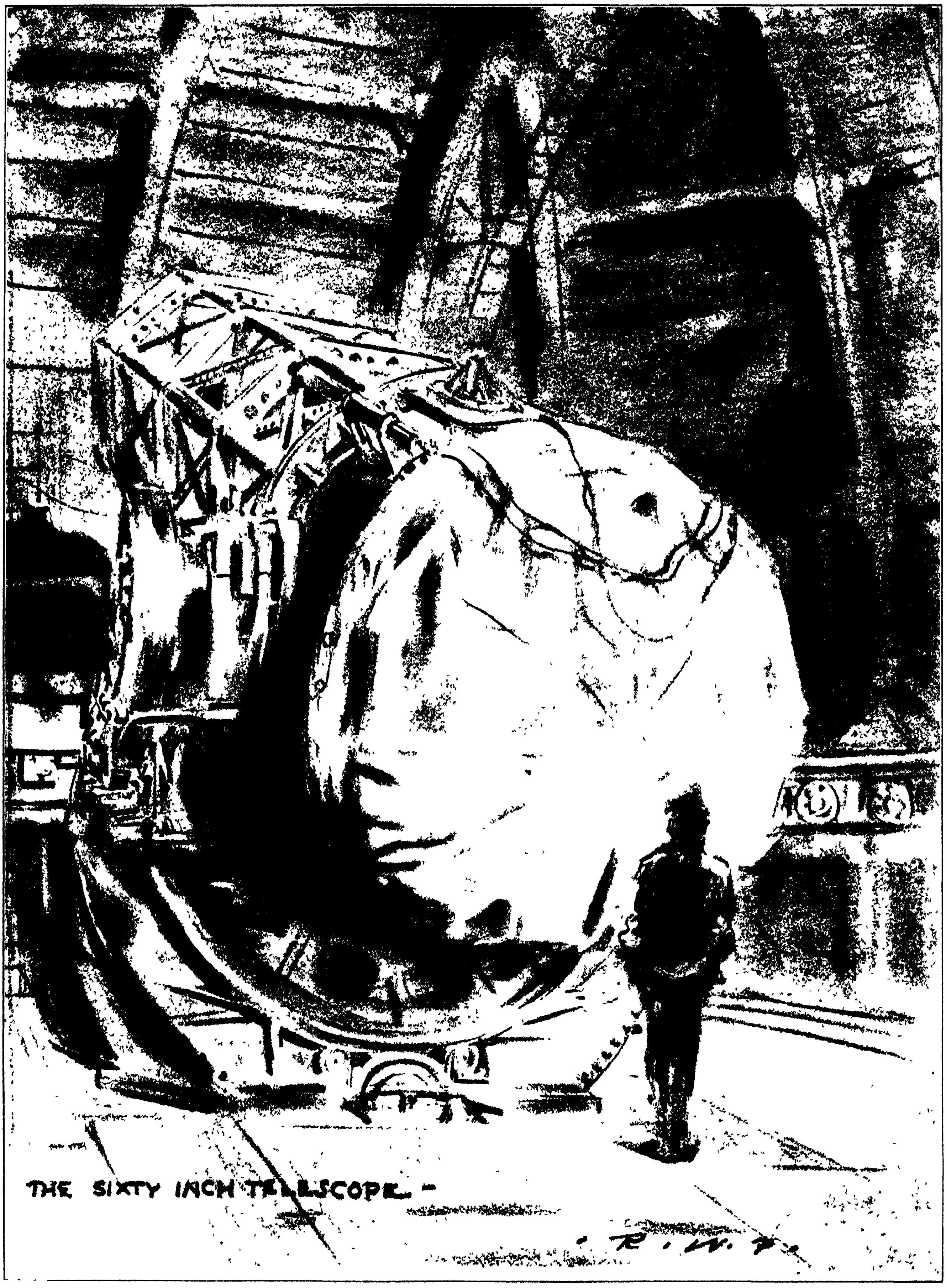
Photograph by David B Pickering

S. A. Mitchell

FOR the determination of the distances of 1000 stars, Professor S. A. Mitchell, Director of the Leander McCormick Observatory at the University of Virginia, recently has been honored by other astronomers— as Professor Russell explains on page 280 of the present number. The stars whose distances were determined are within the galaxy —that is, within our own "island universe." They range from six to 600 light years. The work involved no simple, easy "mass production" method of ascertaining these distances, but each individual star required much painstaking labor and application. Dr. Mitchell's prominence in astronomy, however, is based not alone on this kind of research; he is a leading authority on solar eclipses, his large book, "Eclipses of the Sun," being the standard work on every aspect of the subject. Professor Mitchell also has done research at Yerkes Observatory, also at Columbia. He is a Canadian.



THE 60-inch reflecting telescope at Mount Wilson Observatory. A sketch made in the daytime when the observatory dome was closed and the mirror disk of the instrument was further protected against temperature changes by a jacket. Russell W. Porter, the artist-astronomer, called this sketch "The Slumbering Giant." Further details will be found on page 256. The tentative design for the 200-inch reflector (see front cover) employs a similar mounting, largely because it has proved so satisfactory on the much admired 60-inch instrument

A group of members of the American Association of Variable Star Observers visiting Georgetown Observatory during a Washington meeting. About half are "professional" and half "amateur" astronomers, but in astronomy such a distinction seldom is made, because the amateur has done so much professional work in the past

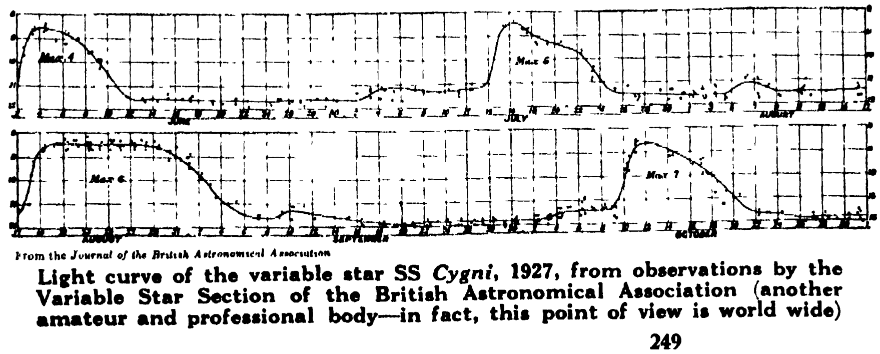
One Touch of Nature

By DAVID B. PICKERING

The American Association of Variable Star Observers

OF the tens of thousands of millions of stars which photographs taken through the world's great telescopes will show us, all but a few thousand, a mere handful, are staid, well balanced citizens of space. All, of course, are suns, larger and brighter on the average than our glowing orb of day, but so vastly distant that they appear but as points of light even through our most powerful instruments. In human affairs our concern is with those who disobey the laws of society and ignore its conventions. Even so, in the world of stars we are drawn to those nonconformists whose vagaries, in many cases, seem to be beyond the pale of the law. Unlike their more regular brethern, they dare to change their brilliancy—throwing into space at times vast quantities of light; while at other times, so prodigal of this commodity have they been, that they shine with but a fraction of their former brightness.

The basic laws that underlie these changes in brilliancy are, in many cases, still a mystery to man, but his urge to know the truth impells him, nevertheless, to study them with sometimes passionate intensity. These lawless ones are known as variable stars. In the catalogues of the heavens they are designated by certain Roman capital letters, and the name of the constellations in which they appear. Thus we have SS *Cygni* –the variable star SS in the constellation of Cygnus, the Swan. To an observer with a small telescope, this star remains in comparative obscurity for an indefinite period, and then with startling rapidity grows in brilliancy to nearly 100 times its former state. It is one of the most mysterious and and therefore most famous of all variables a veritable François Villon of the skies, whose next daring move his closest observers may not even guess.



From the *Journal of the British Astronomical Association*

Light curve of the variable star SS *Cygni*, 1927, from observations by the Variable Star Section of the British Astronomical Association (another amateur and professional body—in fact, this point of view is world wide)

LET us recite an emotional experience from the life of any variable star observer:

"Watchman, what of the night?" Many times throughout the day this phrase had trailed dimly through his mind as he sat in his stuffy office in the city, immersed in the details of accounts. Many times he had glanced quizzically through the window at the occasional clouds that sailed above the sea of brick and stone without. Later, from the window of the train that bore him to his suburban home, he noted with a thrill that the October sun decended through a cloudless sky.

As the evening meal progressed, as the dusk deepened and the lamps were lighted, wife and daughter wondered at his almost furtive manner. The faraway look in his eyes, the air of

"A.A.V.S.O's" hobnobbing. Left to right: Yalden, Godfrey, Miss Cannon, Miss Potter, Dean Potter, Professor E. W. Brown, Olcott

suppressed nervousness, led them to think that perhaps the daily office grind was proving too great a strain. With a guilty smile he excused himself before the meal was finished, and a moment later, as he passed through the dining room bearing the long yellow tube of his telescope, he was abashed by his wife's expression of quiet resignation. But, once the kitchen door had closed behind him, his spirit, imprisoned during the day, rose to meet the stars that kept their tryst with him there in his own back yard.

He clamped the tube of his three-inch telescope into the cradle of the mounting atop the post that stood between the rose bushes, and adjusted the screen that shielded his eyes from nearby lights and kept the vagrant breezes from disturbing his charts on the little table at his side.

Photograph by William Henry, A.A.V.S.O.

Group at an A.A.V.S.O. meeting. Left to right: Pickering (the author), Olcott the founder, Yalden, Professor Harlow Shapley (Director, Harvard Observatory)

NOW his eyes rested for a moment on the stars overhead, then dropped westward to the great Cross of the North that glowed in that group called Cygnus -- the Swan. There on its side it lay, submerged in the depths of the Milky Way. He lighted his dim lamp and let its red rays fall upon his star atlas. How still everything seemed, here in this secluded little garden. He swung his telescope until it was directed toward the slanting cross; then, while glancing at the sky along the edge of the tube, raised it until it rested some distance above the sparkling star Deneb.

He places eye to the eyepiece and cautiously moves the tube, slowly sweeping it back and forth, up and down. In the round, star-filled field of the eyepiece, the bright asterisms assume many and various forms, but with suppressed excitement he seeks one familiar form in particular. It is an "L" shaped group of stars, resembling a carpenter's square, opposite which is a group of fainter stars which, because of its dome-like shape, is known as the "bee-hive." Between these lies a triangle of stars, in which is located that elusive, mysterious variable, known to astronomers as SS *Cygni*.

On every clear night, for weeks past, he has sought this part of the sky found and noted the familiar asterisms of this particular field -but on each night, though he knew the exact spot where it should appear, the object of his quest has eluded him. Last night again, it was beyond the power of his glass. Once more tonight, with the patience of a sleuth, he seeks the outlaw. Ah! here at last is the carpenter's square - and there the little bee-hive.

But--what is this! For an instant his heart seems to have stopped beating then it begins to pound again - he is breathing faster. Something must have happened. Something *has* happened. SS *Cygni* is the brightest star in the field. Sometime within the last 24 hours, this giant sun has burst the bonds of mediocrity and is now radiating with one hundred fold the force of yesterday's energy. No wonder his emotions run riot. Seated here in the silent darkness among his roses, he is the lone observer of this tremendous cosmic event -the witness of a mystery which no man has fathomed.

The kitchen door swings wide. A stream of light from within flows across the lawn to the telescope. A girlish treble calls: "Hey, Dad, you goin' to the movies?"

Tomorrow's paper will tell of the gowns worn at the Vandercliff wedding but there will be no mention of this magnificent gesture on the part of the Creator.

OBSERVING variable stars is the job of a trained amateur astronomer. The word "amateur" means one who does a thing because of his love for it. It is often wrongly applied to a fumbler. I have never known an astronomer—man or woman who was not an amateur. If it so happened that astronomy was also his vocation, his professionalism was quite a secondary matter. What more natural than to find a brotherhood of interest among astronomers, such as exists perhaps in no other branch of science. Quite likely it was this fraternal instinct that, 20 years ago, brought together the late Edward C. Pickering, Director of the Harvard College Observatory, and William Tyler Olcott, an amateur telescopist of Norwich, Connecticut. Pickering, the professional, had a job for amateurs. Olcott, the amateur, was looking for a chance to aid science. Pickering became the "Big Brother" of all variable star lovers. Olcott became the founder of the "American Association of Variable Star Observers."

In was in 1911 that this Connecticut attorney began to enlist the services of other amateurs in the great game of estimating the brightness of the long period variable stars. In that year, seven men formed an Association, and began work. At the end of three years there were about 20 members. Today the Association numbers about 300 men and women in 23 countries of the world.

The fact that some of the stars are not constant, is the "touch of nature" that has "made kin" of hundreds of people all over the world—people

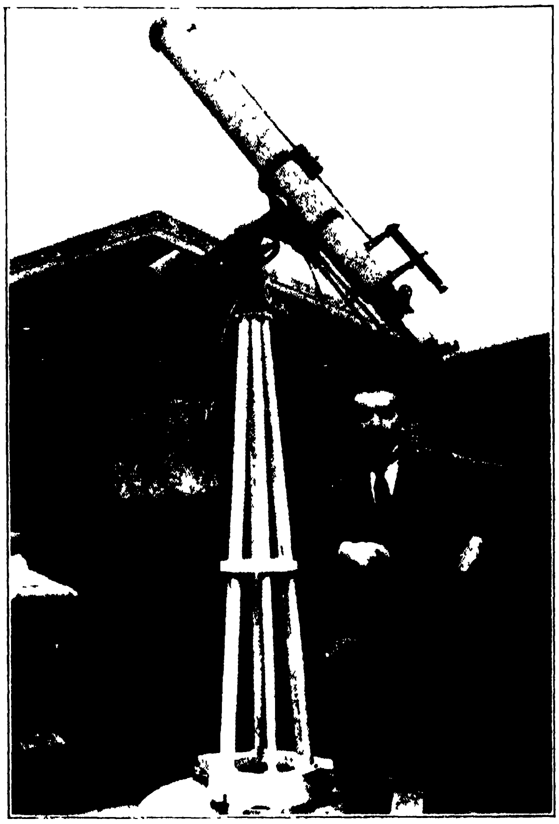
whose vocations are almost as varied in character as are the stars themselves. Among the great amateurs of the country who make astronomy a profession, and who form the solid background and support of the Association, are several famous men, who, though listed as Honorary Members, are active in the extreme. Upon the shoulders of Dr. Harlow Shapley, Director of the Harvard College Observatory—"the man who remeasured the universe"—fell the cloak of that "Big Brother" who was our original inspiration. Professor S. A. Mitchell, the genial Director of the Leander McCormick Observatory—"the man who made a thousand parallaxes"—is devoting himself to the great task of revising our charts; redetermining our fainter magnitudes by the aid of his 26-inch telescope, in Virginia. Professor Ernest W. Brown, of the Yale Observatory, found that the earth and moon were out of step, and set certain members of our Association "marking time" for this pair. Largely through the efforts of this group, he has recently determined that the earth is the culprit—being out of rating to the extent of one second in a hundred years. This friend and companion of ours never misses a meeting of the "A.A.V.S.O."

BUT most of the variable star observers make of astronomy an avocation. There is Leslie Peltier, for example, whose home on the farm lands near Delphos, Ohio, is many miles from a railway. As a boy he would take his little two-inch glass out into the fields, then make his reports of the brighter variables regularly to the Harvard Observatory. Long since he graduated to a six-inch instrument, and for years was the outstanding "ace" among "A.A.V.S.O." observers. Incidentally, Peltier is the discoverer of two comets, one of which is Comet 1930a, the first to be found this year.

Speaking of comets, the second discovery of the year—1930b—was made also by another member of the "A.A.V.S.O.," Max Beyer of Hamburg, Germany. Though a true amateur, and a major contributor to the Association's reports, he is the publisher of the well known Beyer-Graff Star Atlas which so many of us use.

In the little town of Faenza, Italy, the town whose distinctive pottery gave to the world the name "faience"—lived the postal clerk, G. B. Lacchini. With what ardor he loved the stars and with what great facility he observed the changes in the variables, his long record of faithful service, preserved at the Harvard Observatory, will attest. The authorities at Rome, recognizing his rare ability, have recently taken him from the postal service and made him a member of the staff of the Royal Observatory of Catania, thus granting his heart's desire to devote his life wholly to the stars. His little family moved from their home in the north, to far away Sicily. From the shadow of Mount Etna, his charming daughter, Bianca Rosa, sends me occasional verses in excellent English. Today Lacchini contributes more observations to the "A.A.V.S.O." than any other member.

Lacchini and I had corresponded for a dozen years or more. Then one memorable day in 1926, we met in Faenza. It was the first time that Lacchini had ever seen a member of the organization which he had served so faithfully, and for so many years. It was a day to be marked with a white stone. On that occasion, too, I met those fine protégés of Lacchini—Benini and Ancarani—who have remained in Faenza to carry on the work he began. Together with one Gallanti, they have organized the "Osservatorio Urania Lamonia," where, with an eight-inch reflector, the property of the "A.A.V.S.O.," they are doing faithful work for the Association.


The topnotch observer of the "American" Association of Variable Star Observers is an Italian, Lacchini, who lives near Mount Etna

Variable star observers commune at Faenza. Left to right: Benini, Pickering, Lacchini, and Ancarini. The organization is international

In the city of Seattle, Washington, lives another man of Italian birth, D. F. Brocchi, an engineer and draftsman for the Northern Pacific Railroad. He too employs his talents making master charts for variable star observation. Later he checks these with the sky by the use of 10- and 12-inch telescopes of his own making. Lacchini and Brocchi and I have for years been responsible for the chart work of the "A.A.V.S.O." Lacchini and Brocchi have never met. Brocchi and I have never met. We are separated from each other by thousands of miles yet what chums we have become, and what fun we are having, through this common interest.

For many years the head of the "Baron de Hirsch Trade School" in New York City was J. Ernest G. Yalden—the sage of Leonia, New Jersey, whom his friends have affectionately dubbed the "Baron." This tall, bearded genius, with the heart of a boy and the brain of a philosopher, resigned his post some time ago to devote himself entirely to the study of time and the stars. His versatility is astounding—yachtsman, navigator, mathematician, architect, astronomer, and outstanding authority on the ancient art of sun-dialing. He is chief advisor to the Association on observatory construction, and is Chairman of the Committee on Lunar Occultations, another of our important activities.

The Rev. Mr. Tilton C. H. Bouton was a minister of the Gospel in a New Hampshire town when he joined our forces in the early years of our activity. He has since retired and moved to St. Petersburg, Florida, which he chooses to call the "Starlight" City. With the kindly manners of the "old school," with a mind ready and able to grapple with the mysteries of Nature, he has been an example of dependability to his fellow members. He varies his observational and lens-making activities by collecting china and building bows and arrows of rare excellence.

IN 1927 the Association sustained a great loss in the death of its President, Dr. Charles A. Godfrey, a leading physician of Bridgeport, Connecticut. What volumes could be written about his career. He had no means to buy a telescope when as a country boy the stars beckoned to him, so he made his own mirrors and mounted them too.

Another whose memory shall ever be green in the minds and hearts of his fellow members, was Charles Y. McAteer, of Pittsburgh, one of the seven original members of our Association. During his busy, happy life, he spent many hours out of every 24 at the throttle of a Pennsylvania Railroad locomotive. A rack in the side of his cab held a Bible and a star atlas the only guides he knew or required. Finishing his trip when the night was half spent, he would hurry with his telescope out under the stars, there to observe variables until dawn and sleep broke his vigil. "Mac" was a rough diamond but of the first water. The great in science were proud to call him friend.

Today, there are Arthur Butler of the New York Stock Exchange; George Waldo of the press; Ernest Jones of the insurance world; Charles Elmer, the court reporter but space precludes an extended category.

Strange to say, among the 30-odd women who grace the membership of our Association, by far the greater number have chosen astronomy for their vocation. Among the latter who play a prominent part in its affairs, is Professor Anne S. Young, Director of the Mount Holyoke College Observatory, one of our past presidents, and now the editor of our publications.

The president of the Association, at this time, is Dr. Alice H. Farnsworth, also of the Mount Holyoke Observatory, while our vice-president is Professor Harriet W. Bigelow of the Smith College Observatory. Mrs. Margaret Mayall, and Miss Helen B. Sawyer, both of the Harvard staff, are curators of our charts. Dr. Caroline E. Furness, Director of the Vassar College Observatory and author of that splendid treatise, "An Introduction to the Study of Variable Stars," and her assistant Miss Alberta Hawes, are both ardent supporters of the Association and active in its affairs. Equally so, is Dr. Leah Allen, Director of the Hood College Observatory of Frederick, Maryland, and Miss Margaret Harwood, Director of the Maria Mitchell Observatory, on Nantucket Island.

Charles Y. McAteer, one of the seven original members, was a locomotive engineman—"a rough diamond, first water," was "Mac"

Outstanding among the non-professional members is Miss Helen M. Swartz, of South Norwalk, Connecticut, whose devotion to the Association is unquestioned. In Haverford, Pennsylvania, lives Mrs. Otto Haas. Despite the care and responsibilities of rearing her family and attending to her domestic duties, she contributes regularly to our observational records. Still another housewife who devotes her available time faithfully to "A.A.V.S.O." affairs, is Mrs. Mary E. Morris, of Nantucket, Massachusetts.

To our meetings in the spring and fall, come these men and women. Overlords and underlings of big business, professors and students, housewives and teachers, all forgetful for the time being of their daily occupations, they meet on common ground to consider subjects of common interest to revel in the exchange of thought with kindred spirits. It is at these meetings that Leon Campbell, member of the Harvard staff, and dean of the variable star fraternity, discusses the results of our work. As recording secretary of the "A.A.V.S.O.," it is he who prepares our observations for monthly publication in *Popular Astronomy*.

The dinners with which these meetings invariably close are occasions to be remembered. Thereat we descend from heights of pure research to frolic and fellowship. Woe be to him who tries to hide his pet foible under a bushel of dignity; some one will find him out and exploit his weakness either in verse or song. After every such affair, we return to our familiar stars with a better appreciation of the value of team work.

WHAT a satisfaction it is to know that, because of the far-flung membership of the "A.A.V.S.O.," we are enabled to "spell" one another around the world. Perhaps Peltier of Ohio may be watching for a suspected change in the light of some puzzling star; as daylight ends his vigil, and the shadow retreats westward, he knows that there is a long night ahead in faraway Japan where Sigeru Kanda of Tokyo, or Teiju Kanamori of Naganoken, may mount guard over the same field of stars. When the hours of their stewardship have passed, Chandra of Jessore, India, brings his glass to play upon the sky. Later still the charge may fall to Ehric Liner of Konstanz, Germany, or to A. N. Brown of London. Thus when night again falls upon America, we may feel assured that the sun has not thwarted us.

But, despite this pretty system and these widely separated stations, the Association needs more workers. There are hosts of long period variables and never enough observers to follow all their caprices. We will gladly lead the amateur telescopist into the pleasant and profitable pastures of the variable stars. Through personal contact, by correspondence, or by the aid of literature and charts, we will instruct him in our methods and impress upon him the great assistance which his subsequent service will afford to science. Then, when he has acquired the knack of finding the star fields and estimating the brightness of the stars, and has assured us of his intention actively to co-operate with us, we will welcome him to membership in this happy fraternity of ours.

The very hope of adding one jot to the sum total of accumulated knowledge, seems sufficient reason for anyone to devote time and energy in the pursuit of truth. Perhaps another urge may lie, however, in the response of an eminent man of science when asked why he had given his life to research:—"Because it's so much fun."

OUR POINT OF VIEW

Glenn Hammond Curtiss

THE news of the untimely death of Glenn H. Curtiss at the age of 52, on July 23, came as a shock not only to the aviation world, of which he was one of the few outstanding pioneers, but to the world in general. Inventor, pilot, and manufacturer, he was in turn a bicycle racer and repairer, a motorcycle manufacturer, the first man to make scheduled airplane flights, and finally, an airplane manufacturer. He contributed more to the development of heavier-than-air flight than any other man, and much of America's success in building planes during the war was due to his genius.

After winning many trophies in bicycle racing, Mr. Curtiss made a 10-mile motorcycle record that stood for 16 years. Next he built a motor for an airship, the flight of which was so successful that the government ordered a dirigible. When this was built in 1905, it passed all tests and became Army Dirigible 1. Together with Alexander Graham Bell, he formed, in 1907, the Aerial Experiment Association and built the *Red Wing* which cracked up on its first flight of nearly 319 feet, the first public airplane flight in America. On May 22, 1908, Curtiss flew his second plane, *White Wing*, a distance of 1017 feet and landed safely.

The first previously announced flight in America was made by Curtiss when, on July 4, 1908, he won the first leg of the SCIENTIFIC AMERICAN Trophy by a flight of one kilometer in the now famous *June Bug*. His attempt to take off from the water in the *June Bug*, refitted with pontoons, was unsuccessful but the attempt led to the development of the flying boat which he perfected in 1912.

The second leg of the SCIENTIFIC AMERICAN Trophy was won by Curtiss in the first exhibition flight in America at Hempstead Plains, Long Island. This flight covered 24.7 miles. Then on May 29, 1910, came his greatest triumph: a successful flight down the Hudson River from Albany to New York City by which he won the *World* prize and the third leg of the SCIENTIFIC AMERICAN Trophy, the latter then becoming his permanent possession.

As a builder of planes, Curtiss designed and produced many machines of distinctive design and developed many types of aeronautical motors. In recent years, however, he had relinquished all active interest in the aviation companies that bear his name.

It will be impossible ever to calculate the debt which the world owes to Glenn H. Curtiss but it is an assured fact that aviation will place him forever on the pedestal beside the Wright brothers and Langley. While the world pays tribute to the energy and versatility of the man, SCIENTIFIC AMERICAN, because of its close touch with him during the early skeptical days of aviation, feels that it has suffered a distinct, almost personal loss.

Helping the Deaf

THE almost overwhelming noises of our great cities and of our industrial plants are said to be causing a large increase in the number of the cases of deafness. And it is now understood that deafness frequently tends to cause a mental slowing up and, in some cases, does cause a positive dullness.

The importance, therefore, of the efforts of the Chicago League for the Hard of Hearing to encourage installation of hearing aids on certain seats of churches, theaters, and other large auditoriums so that deafened people may hear and enjoy sermons, music, entertainment, or whatever program is being given, can readily be realized. There are in this country, the Hearing Aids Committee of the above-mentioned organization says, 10,000,000 deafened people, 300,000 of whom are in Chicago. Most of these people have ceased to attend church, cannot enjoy the drama or educational talks, and, since the advent of talking movies, are denied even the pleasure formerly afforded by silent movies. The Committee is backed, in this work, by prominent Chicago organizations.

We wish the League a full measure of success. Theirs is a splendid undertaking and we hope it will be followed in other cities. The world of the person who is hard of hearing is narrow and dreary indeed, and we who have our hearing should extend to him, as much as possible, the means of enjoying the entertainment and cultural programs which so often satiate us.

Before the Accident

DESPITE the disastrous nature of the World War, *The Travelers Standard* voices the opinion that it served a great purpose. It showed how exceedingly horrible a modern war can be and turned men's minds more definitely toward the prevention of future wars. Similarly, the sinking of the *Titanic*, with the loss of 1500 lives, was, it is pointed out, a beneficent disaster because it brought the realization that additional marine safeguards and an ice patrol of the North Atlantic were needed.

In industry, the thousands of safety inventions and devices—mechanical guards over moving machine parts, goggles and masks for workmen, safety valves, protective clothing, and so on—were all born of human agony and sorrow. Someone had to suffer before foremen, plant superintendents, and executives could realize the hazards of old methods.

It is a puzzling and unfortunate fact that foresight, in the matter of industrial safety, has been and is lacking as a rule. The workman has had inculcated in him the spirit of efficiency so that he takes an interest in his work, but he has not yet fully felt the need of accident prevention measures and devices. Working on machinery that is well-protected, he often removes safety devices in the belief, apparently, that he can do his work faster or with less effort.

Some plants are making great advances in safety. In these, workmen are taught the meaning of accident prevention measures and are encouraged to look ahead and devise safer methods of doing the things they do every day. But the toll in fatalities and injuries is still far too great. If the human equation is to blame, then change it by an intelligent educational campaign. The result will be safety before, not after, the accident.

International Affairs

THE THREE POWER NAVAL PACT

PRESIDENT HOOVER won a decisive victory in the prompt and almost unanimous ratification of the naval pact by the Senate. We believe the Senate reflected the public opinion of the country in their action; nevertheless the outcome is a personal triumph for the President, and coming at the close of a Congressional session where his leadership had been several times repudiated, it must have been gratifying. We believe the President deserves all the prestige he has gained by his patient and tactful handling of this difficult problem.

At the same time we entirely understand and sympathize with the patriotic motives that inspired the small group of Senators, ably led by Hale and Johnson, who unsuccessfully opposed the ratification. There is no gainsaying the facts they brought out

(*Please turn to page* 328)

The "bathosphere" emerging from a quarter of a mile dive. Note the cannon-like eyes

A 1400-foot Dive

By OTIS BARTON

THE 13th expedition of the Department of Tropical Research of the New York Zoological Society under the direction of Dr. William Beebe has had a very successful season in Bermuda and our knowledge of undersea life has been greatly enlarged by the use of the "bathosphere," designed by the writer and Mr. J. H. J. Butler. This spherical steel diving chamber or tank is a single steel casting fabricated by a firm specializing in hydraulic machinery. The first casting weighed five tons, and proved too heavy for Dr. Beebe's winch. This casting was therefore junked and another "bathosphere" weighing 5000 pounds was substituted. It is four feet nine inches in diameter and its walls are more than an inch and a half in thickness to resist the enormous pressure that is found at great ocean depths.

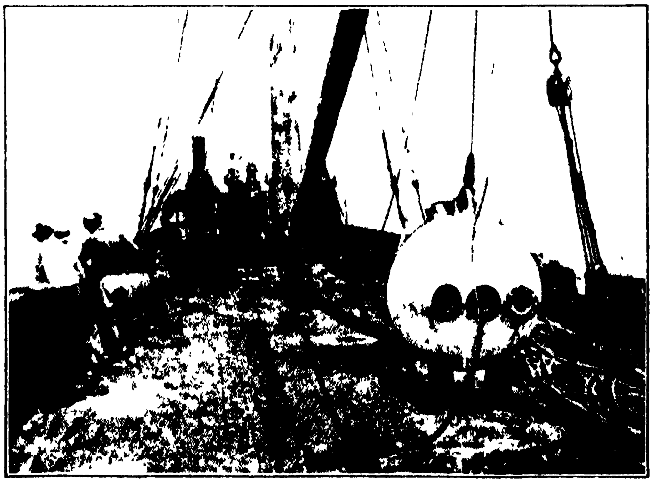
Access to the sphere is gained by a 400-pound door in the rear. It is secured with ten large bolts. In the center of the door is a wing-bolt plug which can be quickly screwed in or out. The door has a circular metal gasket which fits into a shallow groove. This joint, when packed with a little white lead, was entirely waterproof at a test submersion of 2400 feet.

THE windows in front are cylinders of fused quartz eight inches in diameter and three inches thick. They are a special product of the General Electric Company and are fitted into cannon-like projections in the front of the sphere. The joint is secured by a paper gasket and with white lead, and a light steel frame is bolted over the front of each window. In all we had five quartz windows. The first was chipped in an attempt to grind it into its seat. The second gave way under an internal pressure test of 1250 pounds to the square inch. It seems probable that the frame in front was bent and that the resulting shearing strains broke the glass. The third was broken when the frame bolts were tightened unevenly. The remaining two, however, have never leaked a drop, have withstood the pressure under test at 2400 feet, and will no doubt stand much more. We were obliged to seal the third projection with a steel plug.

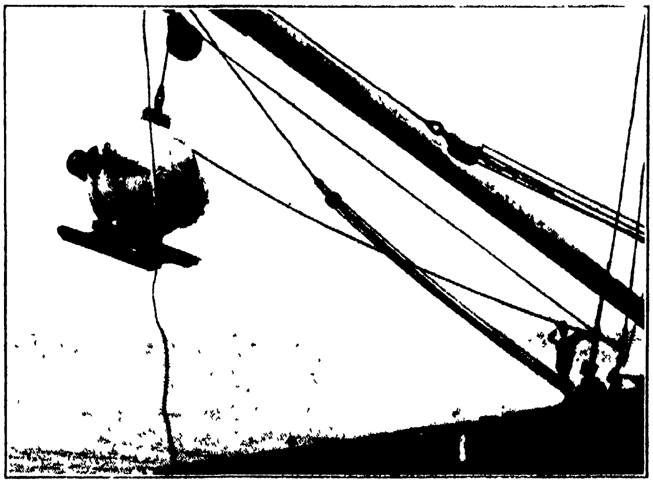
The electric cable was specially made. It is one and one tenth inches in diameter and has heavy rubber insulation. Inside are two conductors for the lights and two for the telephone. The cable passes through a stuffing box in the top of the tank and is squeezed up by two glands, one on the outside of, and the other within, the sphere. The glands proved entirely waterproof under all pressures we encountered, but the higher ocean pressures caused the electric cable to slip in through the stuffing box. It was this which turned us back at 1426 feet. Eventually we succeeded in jamming the cable with friction tape.

The two largest conductors passed to a 150-watt spot light in the right forward projection. At depths of over 700 feet the beam of light could be seen passing through the water. When more illumination was desired, it was simply necessary for the divers to direct the deck crew, by telephone, to speed up the generator. The light was turned out by the divers when they wished to observe the effects of the natural submarine illumination. To facilitate these observations the entire interior of the sphere was painted black. All observations taken in the depths were recorded by the deck crew.

THE breathing apparatus employed was designed by Dr. Alvan Barach of New York. Clamped to the wall of the sphere were two oxygen tanks, either of which would take Dr. Barach's special valve. We set this valve to allow two quarts of oxygen per minute to escape for the two divers. At this rate, one tank lasted



The "bathosphere" on the deck showing the "eyes." The winch and the steam boilers are at the left and Dr. Beebe (hatless) may be seen looking over the rail



The "bathosphere" is swinging outboard for the dive. Note the skids and the electric cable which carries all the wires for the telephone and electric lights about three hours. Above each tank was a wire mesh tray. One contained soda lime, which took up the carbon dioxide. The other held calcium chloride which absorbed the moisture in the air. Palm leaf fans kept air in circulation. During our deepest dive of 1426 feet we were comfortable and cool, although we were inside more than an hour and a half. The physiological balance was excellent, although after a long dive there was a slight excess of pressure. This we noticed on our ears when the central plug was unscrewed upon reaching the surface.

We always entered the sphere head first, wriggling our way through the narrow manhole. There were no cushions on the floor, for these might hide some of our small implements or obscure leaking drops of water. Our bodies, however, fitted comfortably against the rounded steel walls. The door was put in place with a small hoist. The pounding down of the ten bolts and central ring bolt plug created a fearful racket in the interior. The jarring, however, never seemed to affect the quartz windows.

THE "take-off" always felt smooth, like that of a dirigible. In the air the "bathosphere" swung like a hammock. At times we almost began to feel seasick. Once in the water, however, all was well. We were steady and cool and only knew when we were being lowered by the jerking of the steel cable.

For lowering the ball, we used Dr. Beebe's five-ton winch and special large reel. To operate these, we installed two boilers on the after part of the long deck of our 130-foot lighter, which had once been H. M. S. *Ready*. The lighter was in turn towed by the tug *Gladisfen*, of the New York Zoological Society. This equipment was used on the Arcturus expedition, as were also the three six-ton sheaves. One of these was bolted to the deck about 60 feet in front of the reel, which was amidships. From this the cable returned to the second block close to the mainmast and then passed to the third at the end of the heavy boom.

The cable was a special seven-eighths-inch steel-center non-spinning type, 3500 feet long, capable of sustaining 29 tons. The amount of cable paid out was tallied by a special meter wheel from the *Arcturus*, as well as by a system of ribbons tied around the cable.

The comparatively light electric cable was let out by hand, and attached at intervals of not more than 200 feet to the steel one. This was done at first with brass clamps, but later it was found better to tie the cables together with lengths of rope about a yard in length, since these took up much of the twisting. The winch was stopped while the tie was made.

Two of the three windows are closed by heavy three-inch quartz plates

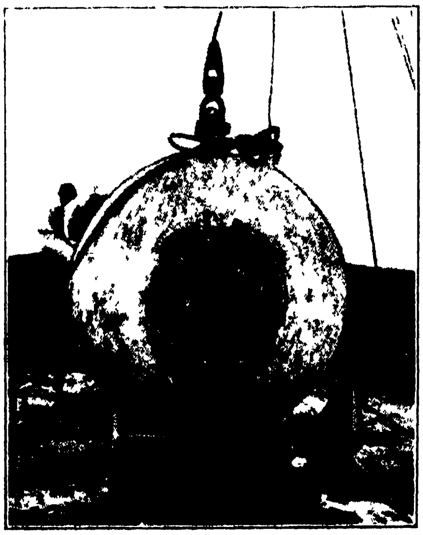
Several problems were naturally encountered in these operations. Perhaps the greatest trouble was caused by the twisting of the rubber hose about the steel cable. When twisting was bad we would tie up loops every 200 feet in a loose coil, through the center of which the steel cable continued to operate. Finally, however, we succeeded in getting out as much as 2000 feet without twisting.

Besides taking observations at great depths in the open ocean, we tried towing the tank along under the vessel, endeavoring to keep the bottom in sight and not to run into any ledges, which rise up quite suddenly in these waters. In this work we nailed a wooden rudder on the rear end of each skid, by which the windows were kept always to the front in the direction of motion. A brace of fish hooks was also attached on a frame outside the window. These proved very sensitive indicators of the currents.

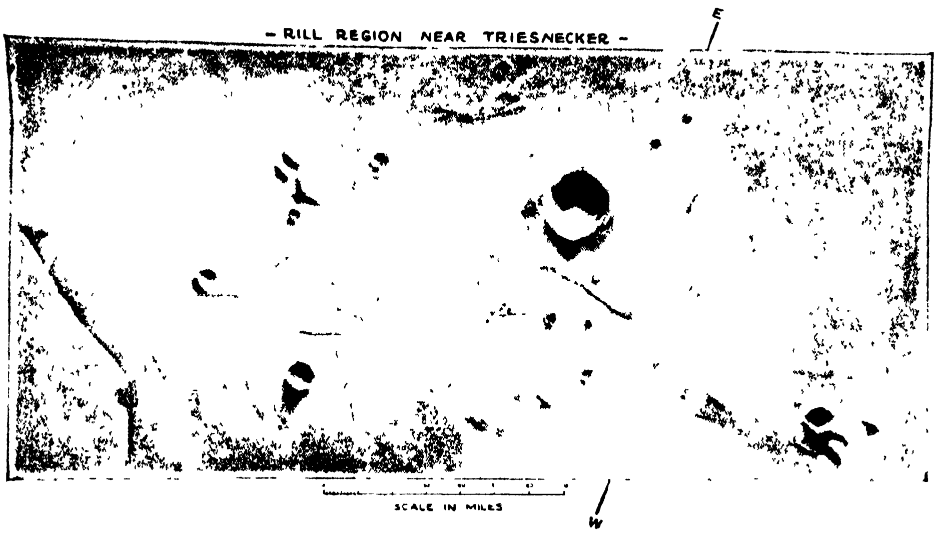
Tangle of steel and electric cables on the first test dive of 2000 feet

It is with this outfit that we hope next season to study the contours of the bottom down to 500 feet and also to make dives in the open ocean of 2000 feet. The margin of safety seems entirely satisfactory.

Besides the use of the "bathosphere," intensive trawling with meter nets was done, as well as some bottom dredging with the aid of the five-ton *Arcturus* winch. One of the chief objects of the expedition is to determine the continuity of fish life which connects the mid-water zone of one hundred fathoms with that of the ocean's floor two miles down. The expedition has been rendered possible by the generosity of two members of the Society's board, Mr. Harrison Williams and Mr. Mortimer L. Schiff.



After the divers enter the sphere and the four-hundred-pound door is fastened with ten bolts, they are ready to start for "Davy Jones's Locker"



Rill region near the lunar crater called Triesnecker. The drawing extends across about one eighth of the moon's diameter. Lunar "rills" are deep, narrow, crooked depressions, resembling valleys

Moonscapes

A Letter from RUSSELL W. PORTER

Optical Associate, Jones and Lamson Machine Company, Associate in Optics and Instrument Design, California Institute of Technology Contributing Editor

ONE of my red letter days came at Mount Wilson when it was suggested by the astronomers that I try my hand at drawing details of the moon's surface—details which are too small to be recorded on photographs. Previous work of this kind, done some years before, together with a facility in using a pencil, made it seem likely that, provided the seeing was good, I would be able to transfer to paper certain lunar objects or markings which would be of value and serve as a kind of standard of seeing.

Unfortunately, the nights allocated to me turned out to be accompanied by relatively poor seeing—from 1 to 3 on the familiar Harvard scale of 10. Therefore these three moonscapes have no particular scientific value, but fall into the category of interesting sketches. Nevertheless, the thrill I got at the eyepiece of the 60-inch telescope during the few hours available will live with me for many a day.

The instrument itself, which I first sketched by daylight [see page 218—*Ed.*], is one of the largest of reflectors, and is greatly beloved by the astronomers. To me, as I sketched the monster taking his afternoon nap, bathed in the dim light that filtered through the shutters of the observatory dome, it seemed to possess a certain sort of personified austerity. If the term "noble" can be ascribed to an inanimate object, I would clothe the wholesome design of the 60-inch reflector with the attribute of nobility.

The moon's image was formed at the Cassegrainian focus near the lower end of the telescope tube, and that night was viewed through a low-powered eyepiece. With the help of the mechanician, Mr. Jones, and the night assistant, Mr. Krisler, my drawing board was fastened with clamps and brackets to the right of and near to the eyepiece, and after many trials was adjusted in such a position that it gave the maximum of comfort and convenience for drawing with my right hand while constantly shifting the eye from the eyepiece to the drawing. A

Region around the moon's north pole, showing the craters of Meton and Euctemon. All of the moon's craters are named and thousands of astronomers, professional and amateur, carry the moon's map as vividly in mind as the map of their own city or state. For many years these "selenographers" have concentrated regularly on systematic programs of observation of certain craters and some, notably Professor W. H. Pickering of Jamaica, believe there are small regular changes due not alone to the gradual shifting of lights and shadows. If these changes are objective their cause and nature are unknown.

The moon's temperature range recently has been worked out experimentally by the astronomers Pettit and Nicholson of Mount Wilson Observatory. They state that "the temperature rises from that of liquid air at sunrise to the boiling point of water at noon; returns as the sun becomes lower in the lunar sky, and hovers near that of liquid air during the next fortnight"—that is, during the long lunar night. Even in the lunar day the temperature of the craters shown above is only about 60 below the Fahrenheit zero, because these craters lie where the sun's rays barely graze them; that is, near the moon's limb

lamp bulb clamped to the board, and shielded from the eye, illuminated the paper in such a way as to approximate in intensity the brightness of the image of the moon itself. The drawing paper used was prepared beforehand by rubbing upon it the powdered dust of a soft pencil lead, until an even gray tone covered its surface. Areas darker than this medium tone were then filled in at the eyepiece, while the brighter areas were picked out with an eraser.

The first attempt was made when the moon was in the last quarter. The telescope was in use by others until 2 A.M. and the drawing was actually commenced about 3 o'clock. After exploring the moon's surface along the terminator, where the shadows model the lunar features to best advantage, I picked out an area near the crater Triesnecker, traversed by a network of cracks known as "rills."

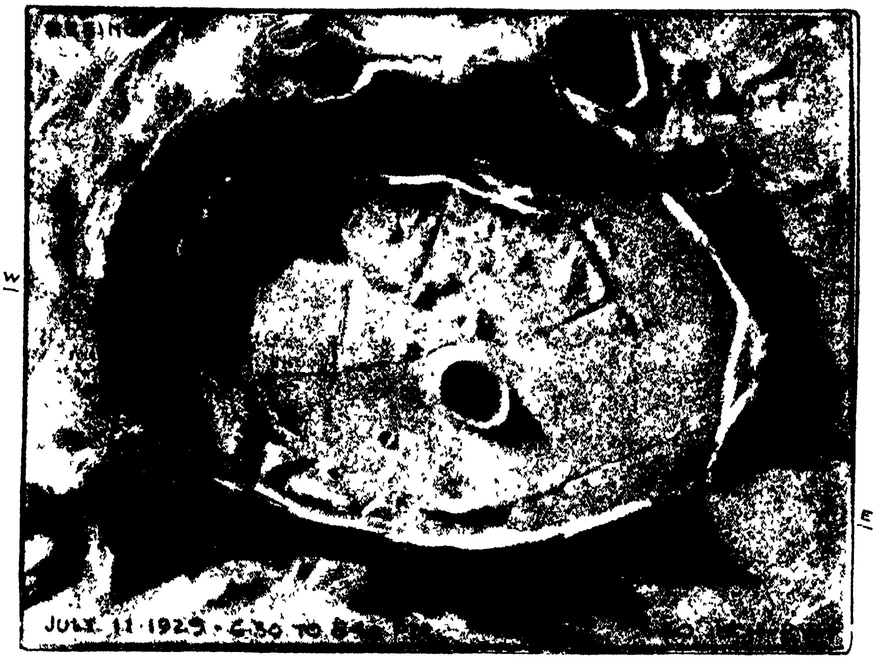
MY time was all too short, for daylight put a stop to the sketching at 5 o'clock. But in moments of better seeing there came fugitive glimpses of minute detail almost too elusive to catch and record. Thousands of tiny craterlets appeared, quite generally distributed over the plains, down the crater slopes and filling the bottoms of the rills. They could not have been far from the order of a few hundred feet in magnitude. These craterlets seem to be typical of the moon's surface.

The other two drawings were made when the moon was in the first quarter. The seeing conditions here were no better than before, although intervals of steady air revealed the great wealth of fine detail so rarely to be caught. Some time I hope to have the privilege of pursuing them further under better conditions, and finally capturing them.

I have been fortunate—or unfortunate—enough to have spent several years in the north polar regions, within a few hundred miles of the pole. These recent nights with the moon vividly recalled the trackless wastes of arctic snow and ice, because of the similarity of the desolate and dead moonscape to our arctic regions.

Through the eyepiece of the 60-inch telescope the moon seems very near, somewhat as though looking down upon it from an airplane. Recently I have seen the moving pictures of the south polar regions, brought back by Admiral Byrd's Antarctic Expedition, and here again the likeness to parts of the moon's surface was recalled. I refer more particularly to those lunar features called "seas," immense undulating plains, slightly crumpled, with here and there apparent cracks running at random—all under dazzling sunlight.

Not long after my final night with the moon I drove through the monotonous deserts of Arizona. A feature lying some seven miles off the trail to the south caught my eye and the car was brought to an abrupt stop. There, for all the world, was a "moon crater," transported to our own earth. Within an hour we were on its rim, looking down into that hole nearly a mile wide and some 500 feet deep. It was the famed Meteor Crater, its origin attributed by astronomers to impact from some celestial wanderer. While I do not advocate the impact theory of lunar craters, a startling likeness to them became apparent when I first saw the profile of Meteor Crater looming out of the desert haze.



The crater of Posidonius. Several smaller craters appear near the crater's rim and a system of cracks covers the floor. Note shadow of peak, near center

Meteor Crater, Arizona, which resembles some of the lunar craters. Professor Henry Norris Russell says: "The evidence appears very strong that this crater has been produced within modern times, geologically speaking, by the impact of a great mass of meteoric material . . ." (Russell, Dugan and Stewart's Astronomy). This also is the point of view of virtually all men of science. On the other hand the majority of astronomers lean, tentatively, toward the volcanic theory of the lunar craters, while a minority hold the meteoric bombardment theory. There is much to be said on both sides. The argument is summarized by Professor Charles P. Olivier in his work entitled "Meteors." He points out that the strongest argument for the meteoric hypothesis of lunar craters is the great difficulties which confront the volcanic hypothesis. The fact that many of the craters overlap, strongly suggests their meteoric origin. On the other hand, the distribution of the craters ought to be fairly uniform if they are of meteoric origin, and it is not uniform. Acres of ink have been spilled in astronomical journals but the question still may be considered wide open. A committee of astronomers and geologists is studing it

Friday: With holystones, plenty of water, and a lot of elbow grease, the sailors aboard a battleship, in bare feet or boots, scrub down the decks in preparation for the Saturday inspection

Housekeeping Aboard a Battleship

By JOHN DONALD THOMPSON

Chief Boatswain, U S S West Virginia

TO the casual observer, housekeeping on board one of Uncle Sam's battleships should be one of the so-called cinches of the world. That an oil-burning ship would get dirty when out on the high sea where no dirt can be tracked or blown in from the land to the decks and into the thousands of places where the good housewife has learned to look, would seem to be just one of those things that could never happen; but such is not the case. It would seem that it must be one of the tasks of life that had been made easy by nature no dust, no mud, nothing very much of anything that is at once apparent to the untrained eye.

Every little crack and crevice aboard must be thoroughly clean

A FEW years ago while crossing the continent on the *Olympian,* I was surprised and somewhat amused to hear the subject of the cleanliness of a battleship brought up and discussed most thoroughly by two men who had recently visited on board one of Uncle Sam's best which is, by the way, still the best at this writing—although I was not a member of its crew at that time.

The ship had interested them very much, and from their conversation I gathered that there was not one tiny speck of dirt on the ship. I, too, became interested as well as puzzled, for that was my job on another one of Uncle Sam's battleships, although it was rather an old one.

While I sat there listening in, I felt like the fox that lay hidden in the brush listening to the two hunters as they discussed the best way to catch a fox. I had been for years trying to keep a battleship clean and am still trying, so, as I sat there listening in, the thought came to me that I would like to tell them something about it and how it was hardly possible to do the things that had so impressed them. But fortunately I kept quiet and the porter, a man wise in the ways of dirt, politely came to the rescue.

"Boss," inquired the porter, "Does yo'all know jes 'bout where dirt is? Jes lots times dey is jes plenty dirt, 'cept you ain't jes know where 'bouts ter look." All said and done, that is the truth.

No matter how much you try, there is always some dirt left. You can wash down and squilgee down the decks most carefully and as soon as the deck is dry, you can sweep down and still get dirt. It can be hidden from the casual observer, and, I sometimes think, from women too, but I have my doubts about the old time skippers. It seems that they find it everywhere—yet we fool them too!

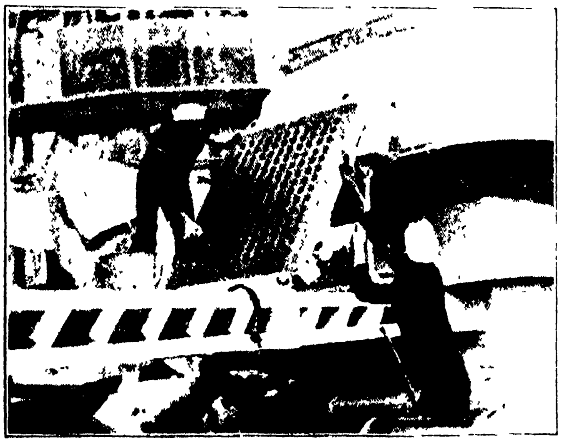
We have a squad—an unofficial squad—with a certain duty to perform. It is this: when the ship has been cleaned up for inspection and as the inspecting party comes along, it is the duty of this squad to cart all the cans of dirt, dirty swabs, brooms, and, in fact, anything that it has been impossible to get rid of, across the deck; then to keep a bright lookout and cart it back as the inspecting or visiting party comes along on the other side of the deck. In effect the result is the

When taking on supplies, a great deal of dirt is dropped on deck from boxes and bags same, but, knowing that the seniors have at one time been juniors, I very much doubt whether the seniors are deceived. But it just has to be done. After the inspection is over, the dirt is put back where it belongs and if you look closely, you will find it. It can not be thrown overboard and on an inspection morning the incinerator just can not burn it all.

It seems that I have had the job of keeping a ship clean for a long time; even before that I had some part of it to look after. I have had battleships for over four years and I know the job fairly well— just fairly well at that.

A few months ago a woman from the middle west came up to me and asked how a ship could be kept so clean. I felt inclined to talk to her and tell her something about it. Usually I duck out of this if I can, but she explained that she was from an inland state where such a thing as a ship had never been and wanted me to tell her how it was done. After I had talked with her for awhile, she became enthused; she thought I should write it up for others to read. It seems a very dull thing to write about—especially after having just published an article about battleships and not one word about dirt.

BATTLESHIPS do get dirty! They have to be gone over most thoroughly each week from stem to stern and from keel to truck. Beside this, many men are engaged in cleaning up very nearly all the time. In a way a ship reminds me of a baby. You clean and polish him up most thoroughly and you dress him up in spotless linens and then you put him down on the floor. If it so happens that you burn coal and have a scuttle full in the house anywhere, that is where you will find him all smudged up with coal. When you get your ship all dolled up, if you happen to be a coal burner, you will then coal ship. If you happen to burn oil it may be lots worse; you may get a cloud of oil half way up the boat deck when a line carries away.



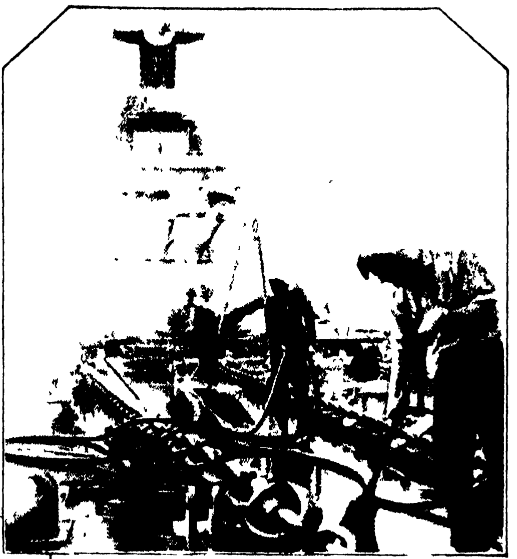
When coming in from a long sea trip, the gangways are cleaned before going over the side

Then we always have the recruit. You watch him. As he walks along the deck he exudes dirt. First he surreptitiously drops a cigarette butt on deck against a stanchion; 10 feet farther on he drops a candy wrapper; after a few moments he shakes out his pockets. After this he starts in to collect more odds and ends which he tries to distribute about the decks with impartiality. He doesn't mean any harm.

One man is chipping a bit of rusty paint-work when one of the aviators turns on the engine of a 200 horsepower motor—the "prop" does the rest. The rust goes far and wide while the ever-moving feet of hundreds of men pick it up and mix it with grease from half a hundred different places while the finely ground dust from the hardwood decks swirls about and collects on the paint work, mixed with the sulfur-soot that comes out from the stacks in clouds when the tubes in the great oil-burning boilers are blown.

The human element is comparable with the mechanical. One of the greatest causes of troublesome dirt is the endless preparation and serving of food. Again the recruit, of whom a large percent of the crew is composed, drops his food far and wide. After a meal, the decks look as if they had never been cleaned up. But as the sailor makes the dirt, he also has to clean it up, so for an hour after meals you see him cleaning up. The dirt he picks up is dumped in the slop box if at anchor, or overboard through the slop chute if under weigh.

It is a curious thing, but the slop box has a name all out of keeping with its real contents. It is called the "honey box"! It holds around 1600 pounds and is filled, much more than filled, each day. It is no small matter to get rid of the refuse in the honey box of a large ship. A great many times it has to be loaded on one of the work-boats and carried out to sea and dumped, otherwise bathing beaches might suffer if located in the near vicinity, not to mention the breaking of harbor regulations that prohibit throwing refuse overboard.



The anchor, coming up from Davy Jones' locker, brings up mud from the bottom. The anchor and its chain must be scrubbed clean

It is an art to keep the vicinity of the honey box clean; I never have for any length of time. Five minutes after everything has been cleaned up, along comes more slop, and there you are.

A BATTLESHIP—any ship—uses much food. Each month we take on about 100 tons on a certain day that is set aside for that purpose. A list of these stores reads like an inventory of a wholesale grocer's combined with a meat packing plant. Each and every box, crate, bag, or frozen piece of meat that comes on board brings its full quota of dirt.

We usually finish taking on stores by noon; then, if my friend from that inland state could see us, she would hastily depart and her report to the folk back home would do us very little good. However, we do not take visitors on board during that time, except in rare and urgent cases.

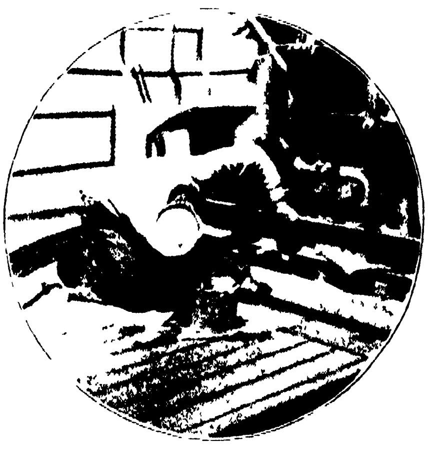
When the ship is got under weigh, the huge links of the chain leave the bottom where they are deeply imbedded in mud and bring some of it up with them, as do the great 10-ton anchors. The chain is washed off with fire hose under pressure, but, mud gets in just the same. I handle the anchors and when I leave the fo'c'sle, it is usually a messy, muddy place—mud, dirty water, and torn up paint work. The boys then go to work and clean it all up again. We average around a

Target practice with the big guns means another cleaning job and a big one at that. Here sailors are seen scrubbing muzzles, barrels, and turrets of guns after firing

hundred of these evolutions each year.

We go out on the target range and after much practice, the actual firing takes place. After firing half a dozen salvos from a battery of eight 16-inch rifles, the ship is all dirty again—and this time she *is* dirty. Not only that, but everything breakable is broken from the concussion, which now brings us around to the seemingly everlasting task of cleaning up once more.

It is said that there is never a time when someone is not painting something on board a battleship. I think this is so on any ship. It is painted and very soon it is scrubbed off—and then painted again. Thus the battle against dirt goes on day after day.



Someone is always busy painting somewhere aboard a battleship

The ship is so large that one man, even in a supervisory capacity, could do very little with it, so the ship is divided into many parts and even these parts are again sub-divided among the men who belong to that part of the ship. Each man then has a very definite part to play in the morning watch when the decks are wet down and the scrubbing begins. Some are detailed to scrub the decks, some scrub paintwork, while still others scrub canvas and look after boats and the endless pieces of gear that go to make a big ship comfortable as well as efficient. Someone is detailed to look after everything.

The amount of soap, soap powder, scrubbers, polish, and other equipment that I serve out on a certain day each week looks like the beginning of hostilities on cleaning gear. I have a weekly issue of cleaning gear, a monthly issue, and also a quarterly issue. One can easily see that soap would be issued weekly; scrubbers and such, monthly; while some items like scrubber handles and scrapers would last for the quarter. However, there is an endless demand for all sorts of gear, no matter how much is served out. It is very little trouble to keep the ship looking pretty and nice if you can get enough cleaning gear and paint.

One issue of cleaning gear is made on Thursday. This is for general cleaning and is made on that day because the following day is Friday which with us is "Field Day"; that means that insofar as possible the day is given over to cleaning and tidying up the ship for captain's inspection, which comes on Saturday forenoon.

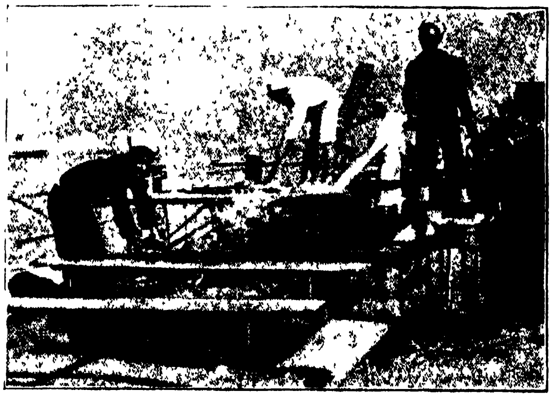
On that day the boys are given 450 pounds of soap; 144 boxes of soap powder; 100 cans of metal polish; 200 sheets of emery cloth; 100 pounds of rags, and a like amount of cotton waste; 50 pounds of air-slaked lime; and one ton of sand! At six o'clock the next morning the boys turn to and spend the entire morning and part of the afternoon in the rather pleasant task of cleaning ship. We still use the holystone on the decks, but I do not believe the boys like that any too well.

There are a good many things about cleaning a ship and keeping it clean without ruining other things as you go along. For example, if you scrub canvas or expensive fire hose while there is sand on the deck, the fabric will very soon be cut to pieces, yet it requires constant supervision to prevent this. One man will be painting aloft; almost invariably if not cautioned, he will spill much of it on the decks below. All of this has to be painfully scraped off. Every spot on the deck—and in the course of a week there are thousands—has to be removed. Lime is used to paint grease spots with good effect, but to complete the job the deck has to be gone over with sand and a holystone.

The modern appliances are great inventions, yet each one adds just so much dirt to a ship. The airplane, for example, one would say, surely could bring no dirt! But such is not the case. It is one of the worst offenders. It spatters oil and grease far and wide. Then, due to the fact that to operate the catapults all the stanchions have to come down, much paint work is torn up. This brings not only paint chippings but rust as well.

The ships' boats looking so trim and neat that you see running between the ship and the shore: surely they can bring no dirt. Once again you are wrong, for when I hoist them in—and that is another job I have—they just drip crude oil. After they are hoisted in, kerosene is used by the bucketful to wipe off the sides. Later, the small barnacles are scraped off and some of this is tracked to all parts of the ship.

ON Saturday morning after inspection, usually the ship is open to visitors and they come by the score from every state in the union. The ship is found to be so clean that one is led to believe that it just came that way—probably out of a band-box. Now when I go home—but I guess I'd better not tell anything about that.



Mess benches and tables are brought upon deck, scrubbed, and rinsed with salt water

A great hill of travertine formed by the flow of hot mineral water

Stone From Hot Mineral Springs

ONE of the oldest building stones with which we are acquainted is travertine. The name is derived from Tivoli, near Rome, where much of Rome's building stone was obtained. Many of the well-known buildings of antiquity were built of travertine faced with marble. Its employment largely depended upon its softness and excellent wearing qualities. Travertine is found as a deposit of calcium carbonate from hot springs, although there is also a silicous type. The cavities which add so much to the beauty of the stone are partly due to the decay of mosses and other vegetable matter.

In 1854 miners prospecting for gold in Mono County, California, found a deposit of stone they called "moss agate" and later it was called marble. It was afterward found to be travertine and the earthquake and fire in San Francisco in 1906 demonstrated the sterling qualities of this building material. The deposit in Mono County is being developed by the California Red Travertine Company of Los Angeles. Modern methods of quarrying are used. The stone when first taken out saws freely and takes a high polish. Some of the stone varies from clear white to gray, cream, and pale yellow. In other sections where the ascending waters have passed through a deposit of metallic oxides, the stone is handsomely banded with other colors. The red travertine is especially beautiful. The designs are largely dependent on the lichens which have grown up along the borders of spring pools and which have been replaced by stone in the course of time.

[illegible]

Upper Right: The water from hot springs has caused a great crack in one of the ridges of travertine in Mono County, California. *Circle:* Some ivory-toned stone of the Roman type being quarried. *Left:* A travertine deposit from which much stone has already been cut. Waters of the hot mineral springs still bubble through crevices. The color of travertine varies from white to very dark red

Can We Signal to the Planets?

By JOHN THOMSON, M.A., B.Sc., Ph.D.
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FROM time to time during the last 50 years suggestions have been made for sending a message to a neighboring planet. In general these suggestions have been scientifically worthless, but for all that the possibility merits consideration. At the lowest estimate a general airing of the question seems to be required, while an accurate statement of the problem and its difficulties is the first step towards any attack which may be made upon it.

The question divides itself naturally into three parts. First, can we send a signal through space so that it may be detected on a companion world? Second, in the event of our being able to do so, is there any possibility of the signal being received and understood? Third. having regard to our answers to the previous questions, what signal would we send?

TO illustrate the difficulties involved, let us consider the possibility of utilizing some form of televisor. In the May "Discovery," (London) mention was made of this means of signaling, and the conclusion rightly reached was that "the prospects of finding planetary neighbors equipped with the necessary apparatus are remote." The complete televisor consists of a transmitter and receiver. The signal propagated through space is, of course, an electro-magnetic disturbance, but this disturbance is obtained at the transmitter from light signals by a series of ingenious energy transformations. Similarly, the receiver, working on the same wavelength, must be able to transform back the electro-magnetic impulse into light signals. Such a process is very complicated and presupposes a vast amount of technical apparatus. But, as will be shown later, in communicating with another planet it is not permissable to assume the existence of any equipment similar to that which we use. The best we can hope for is that our planetary neighbors are aware of the existence of the electro-magnetic spectrum and possess some means of detecting electro-magnetic impulses.

Courtesy American Museum of Natural History

Mars as seen from its outer satellite Deimos. A painting by the astronomical artist Howard Russell Butler. Based on composite evidence.

There is another objection to visual signaling, of an even more fundamental nature. It is probable that the possible inhabitants of another planet react in some way to light signals; this appears to be a necessity for intelligent life. To suppose, however, that this reaction corresponds to our own visual sensations is pure speculation. Assuming that a television receiver existed on the planet under consideration, the picture formed on the screen would in all probability convey nothing to the inhabitants. Hence a scientific approach to the problem demands a form of signal much simpler and more fundamental.

Since we are attempting to communicate from the earth to another planet, and between them no material medium exists, it is at once evident that we must utilize as our signal some form of radiation which is transmitted by a vacuum. This is practically equivalent to saying that we must use some part of the electro-magnetic spectrum. But even a casual examination of the problem is sufficient to indicate that our choice of such radiation is extremely limited.

The mere fact that the solid earth is surrounded by an atmosphere capable of absorbing all radiation to a greater or lesser degree makes our choice a difficult one, while the problem of producing radiation of intensity sufficient to be detected some millions of miles away so far adds to this difficulty that we shall be fortunate to find any type of signal suitable for our purpose. Atmospheric absorption immediately rules out of consideration radiation of short wavelength, since X rays and ultra-violet rays are strongly absorbed by gases. Light and heat radiation do not suffer in this way, but these, as we shall see, are useless for a very different reason. Hertzian waves have been carefully studied in recent years so far as their propagation around the earth is concerned, and it is to such radiation that we must look most hopefully.

FIGURE 1 indicates the relative positions of the earth, Venus, Mars, and the sun when conditions would apparently be most favorable for communication between the three planets. The figure corresponds to what is known as an "opposition" of Mars and an "inferior conjunction" of Venus. It is at such an epoch that these two planets are nearest to the earth. Mars is then on the meridian approximately at midnight, while Venus is (along with the sun) on the meridian at midday. It is instructive to notice that under these conditions the appearance of Venus from the earth is similar to the appearance of the earth from Mars, while the appearance of Mars from the earth is similar to the appearance of the earth from Venus. It is useful to realize the point of view of the possible recipients of our signal.

Now we can not hope in signaling to compete with the sun. If the sun is sending out radiation similar to the one we might choose, then our signal will go undetected. A consideration of Figure 1 will make this perfectly clear. But the sun is continually radiating light and heat, and therefore these signals, as has been stated, may be left out of consideration.

It is obvious then that our attention must be limited to a consideration of Hertzian waves, the type of radiation propagated from a broadcasting station. At the very outset, however, we meet with a serious difficulty. Various writers on wireless communication have described it as "signaling through space," and so far as space is interplanetary, this is just what a broadcasting station does not do. One of the chief reasons why Hertzian waves have become an important means of communication over long distances is that the transmitted signals are confined to a comparatively narrow layer of space in the immediate vicinity of the earth. The signals broadcast do not spread out in all directions; they travel around the earth, practically never rising beyond the limits of the atmosphere.

FIGURE 2 gives a rough representation of the path of a "wireless" ray from a radio transmitter T. The ray may move upward toward a layer of ionized gas known as the "Heaviside layer," but there it is bent downward again toward the earth. A straight beam from the transmitter parallel to the horizon is indicated by the dotted line. It will be seen that the latter could not possibly be detected at any distance from the station, as it would be lost in the upper atmosphere.

This bending of Hertzian waves due to refraction (or possibly in some cases to reflection) is of inestimable value in wireless signaling, and accounts for the remarkably long distances traversed by waves over the surface of the earth, but from the point of view of interplanetary communication the Heaviside layer is an unmitigated nuisance, cutting us off, as it does, from outer space. All Hertzian waves are not, however, equally affected in this way, the bending of the ray varying considerably with its wavelength, and hence it may be possible to find some band of waves which may escape to outer space. Recent experiments appear to suggest that short waves are less bent than long waves, and this is in agreement with the most important theory of the effect. It is probably impossible to produce Hertzian radiation which will traverse the atmosphere in an even approximately straight line, but if the wavelength is sufficiently short, there is a reasonable expectation that the deviation of the ray will be comparatively unimportant. Such radiation has a wavelength of less than ten meters.

Attacking the problem from another point of view, an alternative solution is indicated. Theoretically the use of waves of length greater than 10,000 meters should also obviate absorption and refraction in a layer of ionized gas.

Two possible bands of radiation would therefore appear to be suitable for the penetration of the earth's atmosphere, and we have now to determine which band is more suitable for our purpose in other ways. The question of the intensity of the signal decides, as we shall see, in favor of the short waves. Incidentally, it is useful to note, before we leave this part of the subject, that any radiation which can penetrate our atmosphere will be suitable to penetrate the atmosphere of the receiving planet.

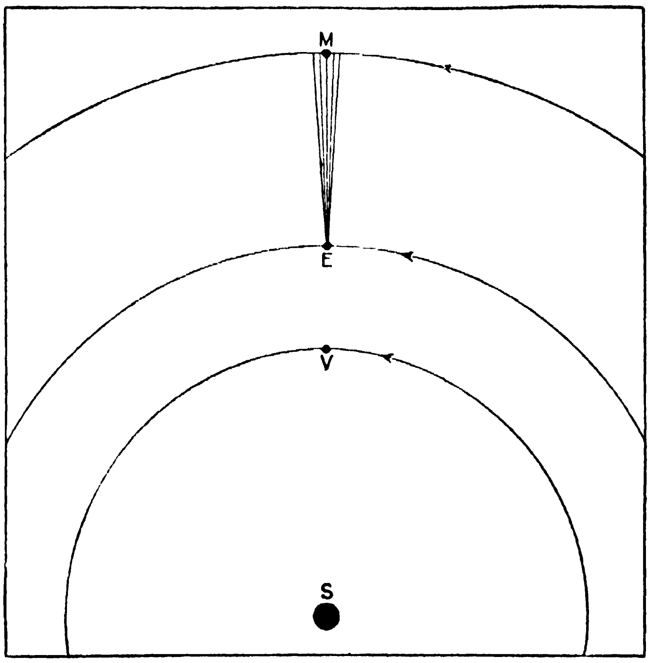

Figure 1: **Optimum conditions for interplanetary signaling between Mars (M), the earth (E), and Venus (V), when all three approach nearest together**

We have said that it is preferable to use a radiation of short wavelength. This arises from the fact that in any attempt to signal over a distance of millions of miles some form of beam is necessary, since, if the radiation were distributed uniformly in all directions a negligible fraction would reach the planet. Now the concentration of Hertzian waves in the form of a beam necessitates the use of a reasonably short wavelength in order that the focusing may be efficient. Hence this is sufficient to decide between the rival claims put forward above.

Having decided on the type of radiation to be used, all that remains is to ask whether a signal of intensity sufficient to be detected can be sent. The answer to this question must necessarily be speculative, for, in the first place, we are not acquainted with any receiving apparatus which the other planet may possess. The signal emitted by our transmitter will suffer attenuation because of two factors. First, the spreading of the beam will decrease its energy per unit area. Secondly, the atmosphere of the earth and the other planet will be the cause of a certain amount of absorption. The spreading of the beam is an unfortunate necessity. By modern methods the pencil of rays could be made very fine indeed, and spreading (except that due to dispersion) could be avoided. But our aim at the planet can not but be very rough, and hence a very fine beam would be almost sure to be lost in space. In Figure 1 a pencil of rays is drawn from the earth to Mars. The pencil shown diverges much more than would be necessary, but in any case its cross-sectional area on arriving at the orbit of the outer planet would require to be at least 1,000,000,000 square miles, in order that there should be a reasonable probability of the planet coming within it.

THE sending of a very powerful short-wave signal is not, however, a very serious matter. Even assuming that the requisite intensity could not be obtained at our present stage of development, the problem is merely one of technique. The wireless engineers are quite capable of producing as intense a beam as we may require when the need for it should arise. The directing of the beam, making allowance for refraction in the upper atmosphere, would be much more difficult.

Assuming then that we are able to send a signal, what can be said of the probability of its being received? Many writers have discussed the possibility of there being intelligent life on other planets, but it must be borne in mind that the whole subject is purely speculative. It does not follow, however, that our speculations are irrational or idle. The modern physicist deals largely and with great success in probabilities.

From a philosophic standpoint it appears improbable that the earth is the only planet in the solar system which is the abode of intelligent life. Apart from all biological considerations, this makes an appeal to our philosophic instincts; anything else would savour of (Ptolemaic) egoism. Moreover, it is utterly impossible to argue that the other planets are unsuited for intelligent life, as has been done so often. Such an argument is founded on the assumption that protoplasm is an ultimate essential of life, while there is nothing to show that it is not the essential of life modified by terrestrial conditions. Even assuming that Martian or Venusian protoplasm would be identical with the terrestrial substance, there is still no sufficient evidence to state that life is impossible on these planets, and, where life is possible, intelligent life is probable.

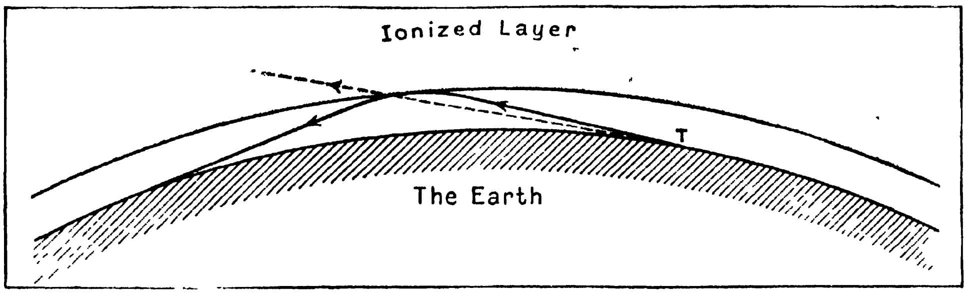

Figure 2: **The solid line indicates the path of a reflected radio wave from a transmitter located at T. A beam parallel to the horizon is shown by the dotted line**

A more important and less speculative question is whether the intelligent life on another planet would be able to detect and understand the significance of a Hertzian wave signal. We must not transfer our own form of intelligence to Mars or Venus, and assume that natural science has been "studied" by intelligences there. We must remember that intelligent beings existed on the earth for some considerable time before any violent interest was taken by them in the phenomena of nature. However, if we assume on the part of these other beings a speculative and experimental interest in the material universe, then we may legitimately hope for some means of detection of short Hertzian waves.

AFTER all, the mechanism of the universe is not terrestrial, and whatever we may think of our conception of Hertzian waves, the waves themselves are common to all space. The reactions of intelligent life on Venus or Mars to material things must necessarily be different from ours, but the reactions must exist, and they will be reactions to phenomena similar to those we experience.

Obviously, of course, the Martian observer will not "listen-in" by means of the mechanism which we employ, and equally obviously the connotation he may give to the signal is beyond our comprehension. At the very best the evolution of an intelligent life on Mars will have followed quite different lines from our own. The accidents of environment will have produced mental processes of which we can know nothing. Indeed, our very terminology with regard to possible inhabitants of another planet will have a wider meaning than the one which we usually assign to it. How far are we justified, for example, in speaking of the "mental processes" of such beings? Yet it must again be urged that the Martian reactions will be reactions towards phenomena similar to those which we experience.

Finally, we must consider what signal we are to send. Here we encounter difficulties quite different from those already discussed. Speaking generally, our message must abstract from human thought and endeavor something which we consider might be recognized as a message from terrestrial intelligence. It would be useless, for example, sending a message in the English language to a French savant, no matter how intelligent he might be, if he did not understand our tongue.

The only ray of hope is our belief that abstract scientific conceptions have a universal foundation in nature. The earth is the third planet in the solar system. No matter how the non-terrestrial intelligence acts, a sequence of three impulses must convey some notion of the number three. Therefore it might be suggested that a beginning should be made in our communication by sending a systematic series of three distinct impulses. We can form no conception of how the Martian inhabitant thinks "three," but it appears probable that our signal would be of a sufficiently fundamental type to cause the requisite mental reaction. If on any occasion it was discovered that signals on the same wavelength were being received consisting of four impulses, we might have some reason to believe that an answer to our signal was being transmitted from Mars. We might, under these circumstances, describe "three" and "four" as the interplanetary call signs.

It may be objected that the suggested message is too simple, and that surely another, conveying more intelligence, could be devised. An eminent astronomer, discussing the possibility of life on the moon, once suggested a signal to our satellite, taking the form of a drawing on the surface of the earth of the requisite dimensions of a right-angled triangle. He argued that this triangle, being of fundamental importance in geometry, would indicate to the possible inhabitants of the moon the existence of intelligent life on the earth. Leaving out of account the fact that Euclidean geometry is but a first approximation to the geometry of real space, did the astronomer not credit the Lunar intelligence with too terrestrial an origin? To imagine that the right-angled triangle, itself a mathematical abstraction, is common to all space, is surely like blaming an Englishman for not speaking Chinese! No! So far as interplanetary communication is concerned, we are strictly limited in our messages to signals of universal nature.

Now that we have considered the various aspects of the problem, we ought to be in a position to say whether the possibility of communicating with our neighboring planets comes into the realm of practical experiment. With regard to our means of sending a message, we have seen that we can hardly be sure that we possess the necessary equipment for making the attempt. On the other hand, researches at present in progress on the electrical structure of the upper atmosphere ought to provide the knowledge of refraction and absorption of short Hertzian waves which we require.

ASSUMING that we can send the signal, whether it will be received or not is a matter of speculation, but we can at least be certain that there is no *a priori* reason why it should not. In any case, the only messages which we can send with a reasonable expectation of their conveying the impression of being signals from the earth are of a very simple and uninteresting nature. Yet the possibility can not be dismissed as a scientific fancy. It lies on that borderline of the practicable which so many of our most important inventions and discoveries have but recently crossed.

¶ *An interesting Hertzian wave phenomenon was reported in 1928 by the Norwegian physicist Stormer. The radio echo around the earth is a commonplace and requires one seventh of a second, but new echoes, delayed 3 to 15 full seconds, were heard. Possible explanations were: the retardation of velocity either in the Heaviside layer or in the earth; or the reflection of the waves from the moon, from the region of the zodiacal light, or from another and a more distant "Heaviside layer."*—THE EDITOR.

Scientific Criminology

How Bullets and Firearms Are Matched for Identification

By STANLEY F. GORMAN

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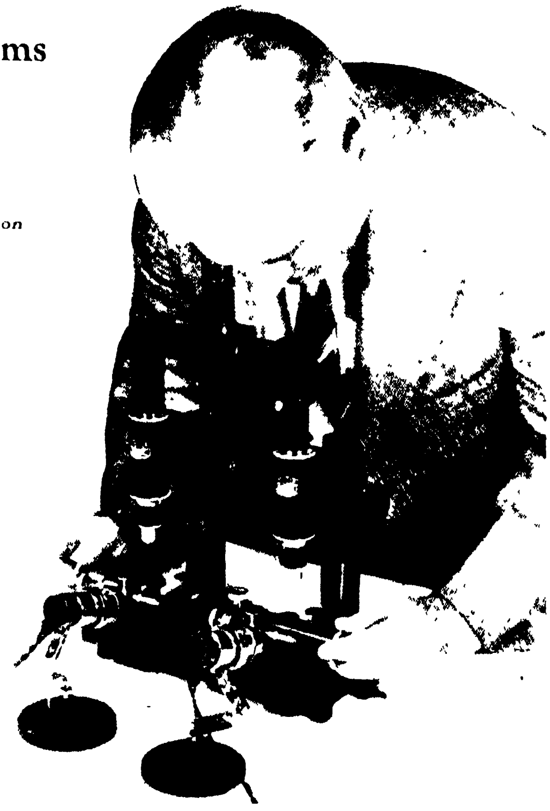
THE most important types of cases a detective has to deal with are homicides, suspicious suicides by means of firearms, suspicious accidental shootings, and assaults by means of firearms during the commission of a crime.

We are all familiar with the fact that, since the war and prohibition, there have been more homicides committed throughout the country by means of firearms than ever before, and it is usual that attempts are made to mislead the detective, either by the perpetrator or witnesses or both, as to the truth regarding the occurrence. It is his duty, however, to obtain facts, present them properly and intelligently, and also to be able to furnish proof of guilt or innocence.

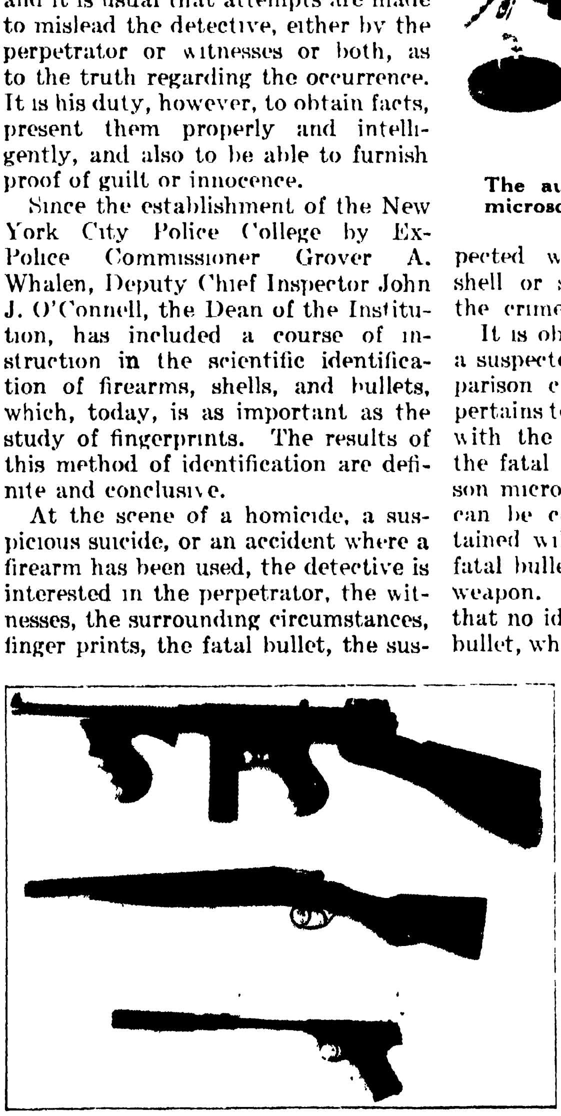
Since the establishment of the New York City Police College by Ex-Police Commissioner Grover A. Whalen, Deputy Chief Inspector John J. O'Connell, the Dean of the Institution, has included a course of instruction in the scientific identification of firearms, shells, and bullets, which, today, is as important as the study of fingerprints. The results of this method of identification are definite and conclusive.

At the scene of a homicide, a suspicious suicide, or an accident where a firearm has been used, the detective is interested in the perpetrator, the witnesses, the surrounding circumstances, finger prints, the fatal bullet, the suspected weapon, and the discharged shell or shells found at the scene of the crime.

It is obvious, of course, that unless a suspected firearm is found, no comparison can be conducted except as pertains to the ammunition. However, with the suspected arm located and the fatal bullet recovered, a comparison microscopic examination and test can be conducted. The results obtained will prove whether or not the fatal bullet issued from the suspected weapon. It must be realized, however, that no identification is possible if the bullet, while passing through the body, comes in contact with bones that cause cuts, grooves, furrows, and so forth, on it, distorting it so completely as to destroy minute important characteristic marks. On the other hand, even if considerable distortion is so caused, but a small side area remains unmutilated, identification can be made. This same condition applies to a bullet which has passed through the victim and has come in contact thereafter with some surface hard enough to mushroom it completely, leaving no portion of the side available for study. If the bullet simply ricochets, however, and only a portion of its surface is flattened or distorted, there will remain sufficient area by which a comparison may be made.



The author at work with the comparison microscope examining bullets in the holders



Guns of gangland. ***Top:*** **A Thompson sub-machine gun.** ***Center:*** **A sawed-off shotgun.** ***Bottom:*** **An automatic pistol equipped with a highly effective silencer**

In order to make clear the fundamental principles by which the expert in firearm identification is guided, it will be necessary first to explain in brief the process of gun-barrel manufacture. Here are born the tell-tale marks that are subsequently imprinted on the bullet when it passes through the gun barrel at the time of discharge. These minute marks give to each gun barrel a personality all its own.

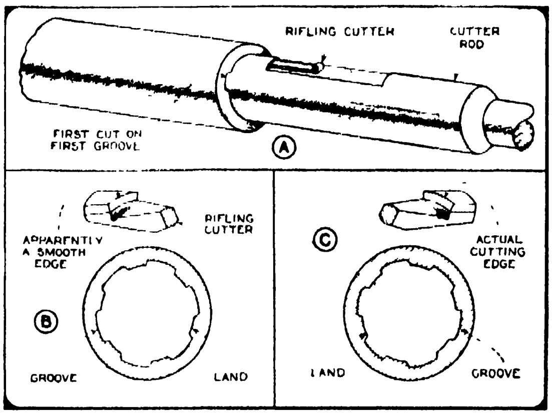
In the manufacture of revolver, pistol, and rifle barrels, the first process is stamping out, by the drop-forge system, the gun-barrel "blank," cut off at the desired length. This "blank" is then bored lengthwise with a drill and finished to the proper size with a series of cutters and reamers. The resulting surface is known as the bore.

THE next manufacturing step is to create what is known as the rifling. This is a series of spiral grooves cut in the surface of the bore from end to end of the barrel. These grooves cause the bullet to spin around its longitudinal axis when fired from the gun. This rotating moment serves to make the bullet stable, so that while in flight it will travel nose first. The grooves grip the bullet at the instant of discharge and spin it as the cord spins a top. Just as the top is rendered stable by its spinning action, so is the bullet. In the latter case, however, a forward movement is imparted simultaneously with the start of the spin.

After these grooves have been cut, those sections of the original bore surface that remain between them are known as the lands. The manufacturers, because of their own patterns for this work, will be found to produce arms which differ in widths of lands and grooves. Some have narrow lands and wide grooves, some the opposite, and some have them equal. It will therefore be found that, in guns of a given make, the patterns of land and groove marks made on bullets fired through them will always be the same, and the same marks or patterns will not occur on a bullet fired from a weapon of any other make. In this way we are able to determine, by examination of a fired bullet, the make and type of arm from which it issued. It should be noted here that the lands or high parts of the bore, cut grooves or low marks on the bullet as it passes through. Thus, on a fired bullet, the low marks are made by the lands, while the high marks or rifling pattern are left by the grooves.

Every manufacturer or ballistic engineer has his own pattern and formula for the depth and width of the rifling, as well as for the rate or degree of pitch. Different manufacturers use different numbers of grooves; some five and others six. The Colt company uses six, while Smith and Wesson use five grooves in all their arms except their .22 caliber, the automatic, and the .45-1917 model revolver, where they use six. The direction of the rifling in the Smith and Wesson arms runs from left to right and the lands and grooves are of nearly equal width. In the Colt guns the rifling is from right to left; the lands are narrow and the grooves wide. All other domestic manufacturers use five grooves and generally run to the right. In foreign guns will be found a mixture of from four to seven grooves running in either direction, frequently in arms of one make.

WHEN considering in detail the rifling or spiral grooves on the inner surface of the barrel, it must be remembered that the physical structure of any piece of metal is not the same throughout. The consistency of the metal varies at intervals; therefore it will be found that in no two gun barrels will the physical structure be identical throughout the bore. This fact has considerable effect on the tool which cuts the grooves, known as the "rifling cutter." These implements are made of the hardest of tool steel, in two styles. One is made in the form of a hook and is known as a "hook cutter." The other is made in a drawn out S shape and is known as a "scrape cutter."



***A:* A rifling cutter starting on the second groove. *B:* How the rifling cutter and rifling should look. *C:* How they are in actuality. All these drawings are exaggerated for clarity**

The cutting edge of one of these tools, when it starts its first groove, is as sharp as a razor. To continue with this analogy: It is well known that after having shaved one side of the face with a razor, it frequently is necessary to strop the blade before shaving the other side. The blade has become dull, due to the action on the fine edge of the hair on the face. This action has in reality changed the shape of the edge. The microscope discloses the fact that a razor edge has teeth similar to that of a saw, although they are invisible to the naked eye. Stropping lines up these "teeth," while use forces them out of alignment: a dull blade results.

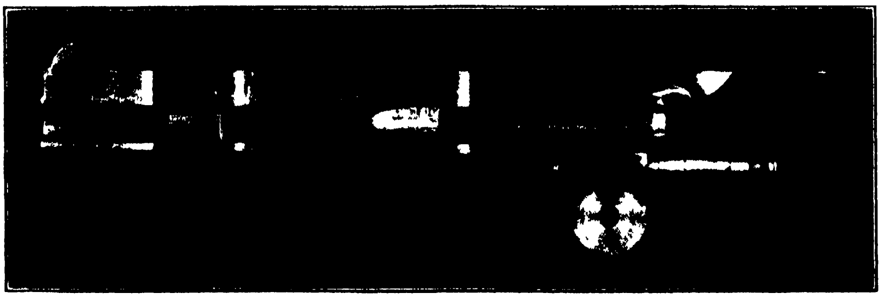
The action on a rifling cutter edge is similar. One can appreciate, then, as the rifling cutter is drawn through the barrel, while the barrel is rotated to give a spiral path to the groove, with the cutter so regulated as to cut $^1/_3$ of $^1/_{1000}$ of an inch from the interior of the bore surface on the first draw, that, considering the hard fine steel edge cutting away a hard steel surface, there is considerable wearing of the cutter edge in one stroke, during which it cannot be "stropped." So the rifling cutter edge is continuously changing its shape and, therefore, the pattern of scratches it leaves behind. The minute teeth on the fine edge are wearing down, chipping off in places, and the edge is scratching its ever changing pattern on the inner surface of the steel barrel.

How two bullets look when viewed through the comparison microscope. The markings on the fatal and test bullets correspond

Another source of tell-tale bore markings is to be found in the slivers of steel that have been removed by the cutter and are constantly twirling around ahead of the cutter within the barrel. They not only create their scratch marks, but they also leave behind marks of "fractures" at the point where the steel sliver breaks from the interior barrel surface. Here another analogy may be drawn. When planing a piece of wood, a thin sliver is removed by the blade of the plane. This sliver eventually breaks from the wood body and leaves a plainly visible scar or "fracture" mark. A similar action takes place within the gun barrel. Considering all these facts, it can readily be appreciated how accurate it is to say that no two gun barrels are alike; and furthermore, that no two groove marks are identically the same in any one gun barrel.

TO the naked eye the interior surface of a gun barrel appears smooth, but by examination with the microscope it is possible to detect, examine, and compare these minute tell-tale marks which have been passed on to the surface of the bullet as it is being forced through the barrel under a pressure of from 8000 to 16,000 pounds to the square inch. This tremendous pressure behind the bullet expands it, pressing it against the inner barrel surface, so that it takes on every minute scratch mark of that surface. Some of these scratch marks, seen under the microscope, are more pronounced than others; one line may be faint at one end and come up stronger at the other; the more the gun is used the more pronounced the scratches become.

If any particular minute defect exists in the barrel or any rust marks are present, the gun's individuality becomes more pronounced and the marks of identification on the



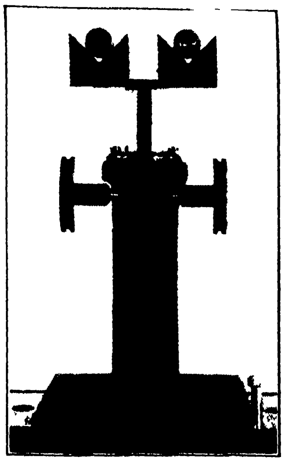
Cut-away view of a revolver barrel, showing rifling. In the barrel has been placed a bullet, on which are seen the "finger prints" made by the bore

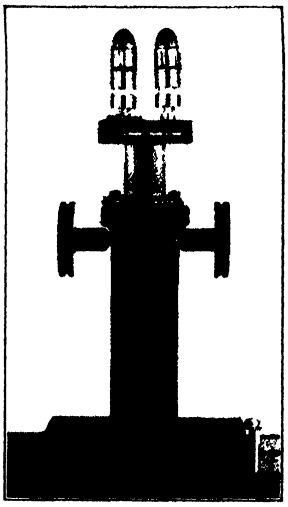
bullet become more positive. It will be noted that those marks imprinted on the bullet as it enters the barrel at the breech end are changed as the bullet progresses through, and it is the marks that are imprinted on the bullet by the last few millimeters of the barrel that serve as the identification card of the gun.

In the case of shell-head identification, the marks made by the firing pin and breech face are the "finger-prints" which must be followed. In the manufacture of the component parts of guns, the same change in the conditions of tools mentioned above gives a starting point for an identification method. If a series of seemingly identical parts, delivered consecutively from the same machine, are examined under the microscope, it will be found that each one differs in some respect from all of the others. The constantly changing tool marks or scratches on the firing pin and breech face are imprinted on the primer as it rebounds at discharge. It is possible to make identification of shell-heads in shot-gun cases in this manner, but because of the smooth bore of the barrel, nothing can be done with the pellets of shot discharged from this type of gun.

IN cases where automatic pistols are used, comparisons can be made of extractor hook marks and ejector rod marks, as well as the breech face marks on shell heads. This same method is used in determining what type of gun discharged a .45 caliber automatic cartridge, which could have been used in a 1917 model Smith and Wesson revolver, a Colt automatic pistol, or a Thompson sub-machine gun.

The method of identification consists of comparing the minute characteristic markings on the questioned or fatal bullet or shell with the markings on a test bullet or shell fired through or by the suspected gun. The bullet fired through a suspected weapon is caught in cotton waste so as not to distort it or cause any foreign marks to be imprinted on it other than those caused by the condition of the interior of the gun barrel.



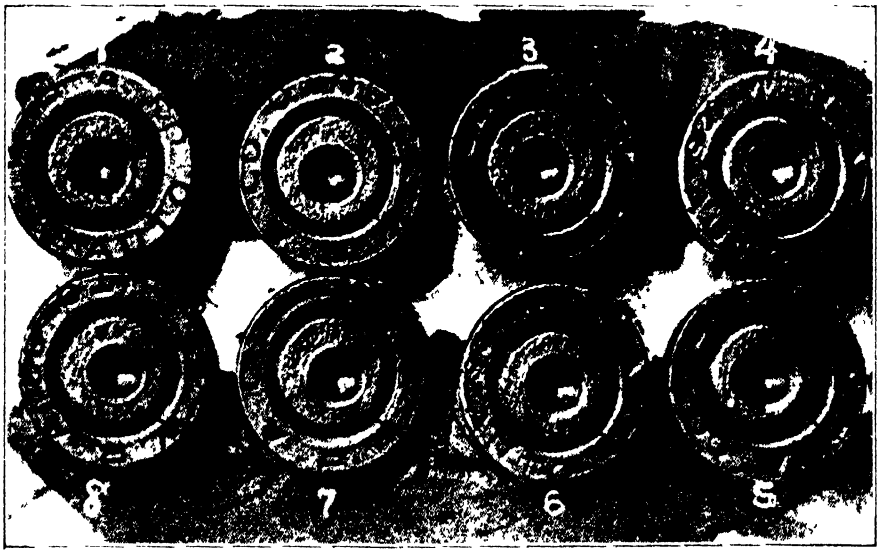


A new instrument designed by the author for holding and manipulating bullets and shells while being photographed. The views show the two different stages that are used

There are today a few experts who make identification in a logical and precise manner but there are also many so-called experts who recognize no limitations, no standards, and no equipment as essential in this field.

In the examination and comparison of fatal bullets and shells fired from suspected weapons, the most important instrument, which is today generally recognized as essential for satisfactory work in this field, is the "comparison microscope" which may be described as a specially designed compound microscope fitted with a comparison eyepiece, in which two bullets or shells can be examined at the same time. With such a microscope the fatal bullet and a test bullet fired from the suspected barrel are placed under the lens systems as shown in the photograph. Their images are fused into one by the arrangement of prisms in the comparison eyepiece. The result is a composite image, one half of which is contributed by the fatal bullet and one half by the test bullet. When the bullets are set in the microscope, they can be rotated independently or simultaneously by means of the mechanical stage.

One bullet is now held stationary, while the other is rotated so as to make various areas of its surface join against the area of the bullet which remains fixed in view. If both bullets are from arms of the same caliber and make, each land and groove mark on the rotating bullet, as it passes a land or groove mark on the non-rotating bullet, will fuse with it as to width and angle of pitch. If the bullets be from the same arm, not only will land and groove edges fuse, and angles be identical, but certain finer scratches from the lands and grooves, mentioned above, will, in some one given position, fuse also. Having located this position, the two bullets are revolved together, whereupon fusion of these fine lines, as well as of groove edges, will take place all around the circumference. Shell-heads are examined in the same way for tool scratch marks left by the breech block as above mentioned.



A row of fatal shells and a row of test shells placed side by side in an accurately bored steel block for purposes of comparison and photography

THE bullets having been examined microscopically and found to match, pictures are taken of both test and fatal specimens. These pictures are so arranged as to enable court and jury clearly to comprehend the result.

There are three pictures taken of the fatal bullet and two of the test bullet. These are arranged side by side in folder form, pasted together on the reverse side, in the following manner. From left to right, number one and two are pictures of fatal and test bullets, respectively; number three and four are pictures of the fatal bullet. The other picture of the test bullet is cut through the short diameter. The lower half is superimposed over the lower half of picture number three, of the fatal bullet, and the upper half over the upper half of picture number four, also of the fatal bullet. The fine lines or striations will match and prove identification.

My Experience in Amateur Telescope Making

By CLYDE W. TOMBAUGH

CLYDE W. TOMBAUGH, author of the accompanying account and the immediate discoverer of Pluto the new planet, "graduated" into professional astronomical work from amateur telescope making, as have several others up to the present time. Until he won a position at Lowell Observatory, Tombaugh was an obscure amateur, one of the 6500 of our readers who have gone in for this fascinating scientific hobby. For some reason he previously had not sent to this magazine a description of the failures and successes in his telescope building, and therefore was wholly unknown to the editors. Acting on a "hunch," when the newspapers stated that Tombaugh "had made telescopes," we found his name in the 1926 records as a purchaser of the SCIENTIFIC AMERICAN instruction book, "Amateur Telescope Making," and invited him to describe his efforts for publication.

Tombaugh's success is a refutation of the assertion, sometimes made, that the layman's worthy work stands little chance of notice by professional men of science. Here we have a plain young man, a farmer, without scientific connection. He makes several telescopes, studies, and wins a position at a noted astronomical institution—all without the least "pull" or preferment. Within three months his name is on every press wire, every cable. If that isn't romance, what is?

IN February, 1926, I began work on my first telescope, an eight-inch reflector, as that was the only way for one of very limited means to possess an instrument of moderate power. The work was new and unfamiliar and mistakes were made; for example, cementing a disk of wood of equal size to the back of the speculum. Another mistake was the flimsy equatorial mounting constructed, which teetered violently with the least wind. The tube was a square box seven feet long, made of four boards nailed together. The telescope was kept out-of-doors and these boards warped sadly in spite of their previous treatment with hot linseed oil and paint. Figuring the mirror was unsuccessful, also the silvering. The return of farm work forbade any further work on the mirror that season.

ABOUT this time, April, 1926, I learned that the SCIENTIFIC AMERICAN had published the book "Amateur Telescope Making," and immediately sent for a copy with the intention of "trying it again" the next winter. The eight-inch telescope was used occasionally during the summer and autumn, though its performance was disappointing. It would stand only the magnification of a two-inch eyepiece, 42 diameters.

A concrete cave (outside cellar) was built on the farm in the late autumn and this was seen to be a fine place to make mirrors because the temperature would remain constant. Work was kept up feverishly to doctor the figure on the eight-inch so that Mars could be observed while near the earth. Nothing but failure resulted, due to the fact that the glass disk was too thin. It showed signs of flexure.

A relative now wanted me to make a seven-inch reflector for him. Here was an opportunity to try fresh glass and to profit from the mistakes made on the eight-inch. Armed now with the book "Amateur Telescope Making," the second project bid fair to be a success, but the first disk cracked while heating it to cement a handle on the back. Another disk was ordered immediately.

The grinding proceeded very satisfactorily and soon was done. The mirror was ground to a focus of 58½ inches. Some scratching was encountered in the polishing, and fine grinding again was resorted to twice to remove the scratches. Upon investigation, the source of the mischief was found to be some grit which had become mixed in the rouge. Polishing was resumed, followed by figuring. "Hyperbolae," "turned-down edge," and "zones" gave trouble and several laps were made in correcting these errors. Finally the mirror was parabolized successfully, placed in the tube and tried on celestial objects for several nights. Views of the moon with a quarter-inch eyepiece were good — much to my joy. Accordingly the mirror was sent away for silvering.

THE tube of the telescope was made of number 22-gage galvanized iron, reinforced by a ring of strap iron at each end, riveted on the inside. A one-inch right-angled prism was used for a diagonal. The telescope was finished just in time, before the annual return of farm work intervened.

In May, 1927, I set out to enjoy the fruits of my labor. The telescope outstripped anything I had previously looked through. Views of the moon and planets with high powers were splendid. With low powers star fields and clusters were most beautiful. From time to time neighbors came to enjoy a look.

One rainy day in August the telescope was packed and shipped to my uncle. I had become so attached to the instrument that I felt the loss keenly.

Soon afterward I ordered disks of glass to build a nine-inch reflector for myself. During a rainy spell in September the rough grinding was done and several weeks later the subsequent work was resumed. A total of 24 hours were required for the grinding process, including careful washing of stand and tools between grades. An 80-inch focal length was aimed at, which later was found to be three-fourths of an inch less. All the grinding and polishing were done by hand. I did not have the time, money, nor inclination to build a machine for these operations. No wooden handle was ever cemented to the back of the speculum.

MY five-year-old brother took keen interest in the project and begged to help. I let him renew the charges of carborundum and water. This saved me the trouble of laying the speculum down and picking it up each time. His enthusiasm and willingness were a source of great joy and inspiration to his big brother.

My father assisted me most generously with the mounting. Ingeniously he fashioned a neat and sturdy one according to my plans from parts of old farm machinery, using only the

The author standing beside his nine-inch home-made reflecting telescope described in this article

tools found in the average farmer's repair shop. Later the performance of the mounting was found to be most gratifying, even when using a power of 400 diameters. The worm-screw slow motion in right ascension, and the turning of the polar axis in its bearings, were uniform and smooth.

The declination axis was cut from one-inch shafting taken from an old straw-spreader. A hardened steel shaft from an old Buick car served for the polar axis. The worm-wheel was made from a spark lever arc of an old car, by carefully filing the notches until they became teeth. The worm-wheel arc is readily clamped to the polar axis for slow motion.

The mounting is of the German type. My father and I forged the yoke from tough, heavy wrought iron. The upper end of the polar axis was threaded and screwed tightly into the yoke. Great pains were taken to fix the polar axis at exact right angles to the declination bearings, the latter being cleanly bored with a hand drill-press, and then treated with fine emery cloth. The polar axis bearings likewise were made with especial care. One could not ask for smoother motion. The polar axis bearings are fastened to the base of an old cream separator whose metal base in turn was bolted to a pier of reinforced concrete.

THE telescope tube, seven feet long and 11 inches in diameter, was made of 20-gage galvanized iron, at a tinner's shop, for a sum of six dollars. Later, at home, two strong bands, one at either end, were riveted by my father on the inside of the tube, giving added rigidity and strength. He also made a cell support in the tube and fitted the back of the cell with three adjusting screws for "squaring on" the speculum.

When the telescope is not in use the tube is capped and the instrument is left out of doors in the snow and rain without injury

The nine-inch mirror rests on a ten-inch disk of walnut two inches thick, and the wood in turn is joined to a fixed metal disk base by the three adjusting screws. This metal disk fits snugly between a tube reinforcing ring in front and three equidistant arcs of strap iron behind. Three evenly spaced gaps were cut on the circumference of the metal disk. By turning the metal disk so that the three gaps come into a congruous position with the three arcs of support the entire cell with mirror slips out of the lower end of the tube. This arrangement allows quick removal and replacement of the cell with its mirror. Dead-black slate cloth was glued to the inside of the tube with shellac to prevent internal reflection of light.

The arrangement used for fastening the telescope tube onto the declination axis will be quite well understood from the photograph. An iron band two inches wide and one quarter inch thick acts as a slip ring. The grip on the tube may be loosened by the handwheel and the tube rotated into any desired position. An iron block tapering off at either end was riveted to this ring. A hole was bored in the block and tapped, and the end of the declination axis was threaded and screwed tightly into this block. This arrangement proved to be quite rigid as well as convenient.

A SMALL optical flat, three eighths of an inch thick and 1½ by 2 inches, intercepts the light and directs it to the eyepiece. It was mounted so as to permit adjustment, and supported by a thin strip of strap iron extending diametrically across the tube.

Considerable trouble was experienced in figuring the mirror, because of the use of too many long strokes in shaping the first polishing lap which was slow in hardening. The first knife-edge test showed the r^2 R value to be one half inch! Serious complications followed in reducing this, and several laps were made and cut up while correcting various errors. The work, consequently, was greatly prolonged. At last the mirror was parabolized to two thirds the theoretical value, in order to compensate for the rapid fall of temperature at night, which is typical of western Kansas in seasons of good seeing.

The optical performance of the telescope is most gratifying. The "double-double" system of *Epsilon Lyrae* is a favorite test for light-grasp, resolving power, and seeing. The components of the two doubles are 2″.3 and 3″.0 apart, respectively. During good seeing these doubles are thrown wide apart, and each spurious disk is very small and clean-cut when using a one fifth inch Ramsden (positive) eyepiece. During moments of extra good seeing arcs of the first diffraction ring are observable, using the full 9-inch aperture. Between E_1 and E_2 are several faint stars. The two stars marked 12.0 and 12.5 magnitudes in Webb's "Celestial Objects for Common Telescopes" were conspicuous. Two fainter stars marked 13.8 and 13.9 magnitudes were just seen and held under favorable conditions. In addition I have seen many very delicate rills and countless craterlets on the Moon. In the autumn of 1928 I was able to observe seasonal changes on Mars and saw a few canals.

Detail of the mounting, made from parts of an old straw spreader, a Buick shaft, cream separator, and several other pick-me-ups

The making and use of my nine-inch telescope has been a source of great pleasure to me, and the entire cost in money, excepting for the eyepieces, amounted to 36 dollars.

The entire telescope, excepting the eyepieces, is left out-of-doors in my "telescope garden." When not in use the tube is held in a vertical position, a tin cap is placed over the end, and a solid dummy eyepiece is substituted for the eyepiece. Thus closed, the tube is practically air-tight. The telescope has withstood the onslaughts of blizzards, driving rains, hail, and dust-storms without the slightest damage. Yet it can be set in operation in two minutes and closed up in five minutes, thus greatly encouraging observation.

A five-inch single-lens non-achromatic refractor of 6½ feet focal length was also made in the early part of 1928. Of course the color is bad and the definition poor due to diffusion. With a two-inch eyepiece it is fairly satisfactory, however.

The following autumn (1928) a Cassegrainian mirror was ground for the nine-inch. Two five-inch specula with focal lengths of 20 and 75 inches, respectively, were also under construction at that time, but early in January of 1929 I was granted work at the Lowell Observatory, and a little later was assigned to the new 13-inch Lawrence Lowell Telescope to search for "Planet X" (Pluto). Consequently my mirror work came to a close, and these mirrors still are unfinished.

Experiments With "Wonder Creatures"

By FRANK E. LUTZ, A.M., Ph.D.
Curator of Insect Life, American Museum of Natural History

ON inviting questions at the end of his first American lecture on the "Mechanism of the Muscle," A. V. Hill was indignantly asked by an elderly gentleman, of what use were all the investigations which he had been describing. For a moment Doctor Hill tried stumblingly to explain what practical consequences might be expected to follow from a knowledge of how muscles work. Realizing suddenly how thankless a task it was to prove to his indignant questioner that the work he was doing was useful, Doctor Hill turned to him with a smile, and finished,

"To tell you the truth, we don't do it because it is useful, but because it is amusing."

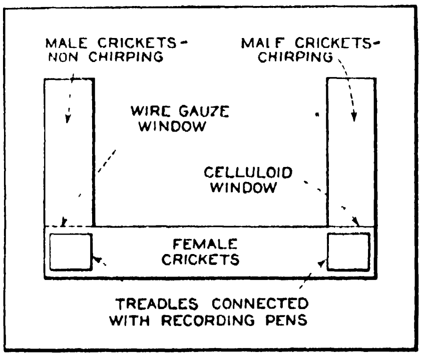
"And if that is not the best reason why a scientist should do his work," says Doctor Hill, "I want to know what is. Would it be any good to ask a mother what practical use her baby is?"

This article is to give you a peep at some of our "babies," glimpses of some of the experiments we have been trying at the American Museum's Station for the Study of Insects in the Harriman State Park and at the private laboratory of Alfred L. Loomis in Tuxedo. They are "babies" in the additional sense that none of them have gone far enough to mature into a definite scientific report.

MOST of the more than half a million different kinds of insects live their lives without a sound that we can hear. A few, however, such as the crickets, katydids, and their relatives, with an originality that is the more striking as we consider the multitude of conservatives, have developed not only rather complicated sound-producing organs, but also apparently satisfactory ears. As is characteristic of insects, they have gone about certain functions in a way and with structures that seem to us strange. An interesting essay could be written on this latter point, telling about such things as that insects take air directly to the blood instead of the rather clumsy human method of taking the blood to inhaled air; and not the least interesting thing about it is that the insects' way seems to work better than our way. An intimation of their success will be found in the last of the experiments discussed in this article.

Several years ago, in reviewing work on insect sounds, I confessed considerable skepticism concerning the utility of these sounds to the sound producers; but the chirping of crickets gave me considerable trouble both then and after the paper was published. The chirping is done by rubbing together highly modified structures on the front wings which seem "made for that purpose." Furthermore, crickets have ears on their front legs, and definite ears are unusual among insects. Since only males chirp (although both sexes have ears) the conclusion has been that the chirping is a sex call.

Having somewhat questioned that conclusion, it seemed only fair that I should test the matter; but watching a female cricket to see if she goes to a chirping male is a time-consuming business and, so, it seemed desirable to invent a machine that would do the job as well or better than we could. Consequently we made an automatic "eavesdropper." It will have to be improved and its first reports are not to be taken too seriously.



The plan of the "automatic eavesdropper" described in the text

A box was made to contain the females. There was a window at each end where two other compartments joined it and here was food and shelter. Each window communicated with separate boxes containing males. One window was covered tightly with thin celluloid that let through the chirps but kept back odors. (Remember that insects have a keen sense of smell and many clearly find their mates by this sense.) The other window was covered with wire gauze that let through the odors and would have let through the chirps also if there had been any in the box with which it communicated. But there were no chirps in that box, because a simple surgical operation on the wings of the males there had completely "dechirped" them without hurting them more than a girl is hurt by having her hair bobbed—and the effect was much the same in so far as they were made more like the opposite sex. The females in the central box could wander about and go to either window. Would they go more often to the one where there were male chirps but no odor, or to the one where there presumably was male odor but certainly no chirps? This is where the automatic eavesdropper comes in.

On the floor of the females' box, just below each window, was a very delicate treadle. When a female came to either window, she stepped on the treadle there and, her weight depressing it, closed an electric switch that completed the circuit through an electromagnet. The magnet drew aside a pen that was otherwise tracing a perfectly straight line on a paper tape moving at a known speed. Each treadle moved its own separate pen. Clearly, all we needed to do was to examine the tape at our leisure and we could tell not only which window was visited but how often the female came, when she came, and how long she stayed.

IN "chirp but no odor *versus* possible odor but no chirp" the females visited the chirp window 290 times and the no-chirp window 307 times. There is practical equality here. When offered a choice between a blank window and one where there were males that could not chirp the score was 170 to 166. Again equality. "Chirp but no odor" won out over "blank" by 63 to 24, but the numbers are rather small and "blank" scored 65 against 48 for a window where there was *both* chirp and possible odor. Males which were offered several of the same choices paid 86 visits to "chirp but no odor" and only 40 to "possible odor but no chirp"; also 80 to "possible odor but no chirp" as contrasted with 44 to a blank window. It seems as though males are more consistently interested in both male chirp and odor than are females, the latter wandering about more or less at random; but that may be a too hasty conclusion.

A few experiments were tried with unmated females whose presumed ears had been removed by the simple expedient of cutting off their front legs. There were 27 visits by these virgins to a window where there were both male chirps and possible male odor and none

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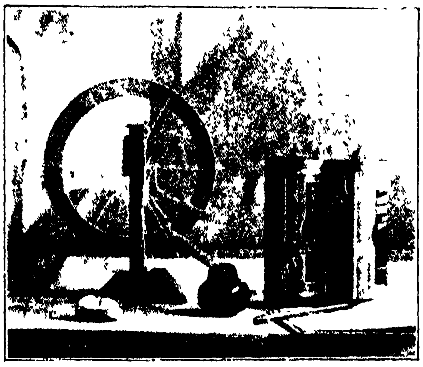
to the other window where there were no males. In another short series of trials where possible odor but no chirps was opposed to chirps but no odor the score was 14 to 11 in favor of odor, but the numbers are too small to be significant. On the other hand, possible odor but no chirps won out over a rival blank window by the rather startling total of 106 to 1.

One of two conclusions is fairly certain: either female crickets do not get wildly excited over the music of possible mates or there is something wrong with the apparatus.

THERE is a very different sort of problem which has greatly interested some physiologists and which may strike rather deeply into the mysteries of animal activities, either muscular or nervous, we are not sure which. For example, Harlow Shapley, an astronomer apparently desirous of improving daylight hours when he could not look at stars, watched ants and noted the speed with which they walked along a path at various temperatures. The warmer it was, the faster they went. A curious thing is that the relation between speed (S_1) at a given temperature (T_1) and the speed (S_2) at another temperature (T_2) closely accords with a complicated formula which represents the speeds of certain chemical reactions at various temperatures:

$$S_2 = S_1 e^{A\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}$$

where e is 2.7183, the base of "natural logarithms," temperatures are measured on the "absolute centigrade" scale ("absolute zero" being about -273° C. or about -459° F.) and A is a constant that is characteristic of the reaction.



Treadmill operated by a cricket. A photo-electric cell recorded the revolutions made by the pedestrian

Some physiologists think that, by a comparison of the "temperature characteristics" of various animal activities (as shown by a curve representing the speeds of these activities at various temperatures) with the "characteristics" of various chemical reactions, we can discover what chemical reactions control these activities. Possibly we can but, at any rate, it is interesting to find out a little more concerning the influence upon insect activities of all the environmental factors, and this seemed to require a new type of apparatus in which the insect could walk straight ahead indefinitely without coming to a wall and in which the environment could be controlled.

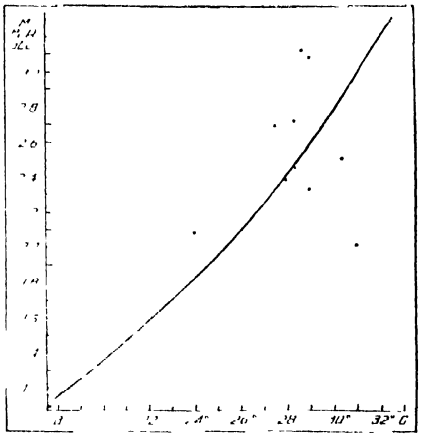
A device something like the wheel in an old-fashioned squirrel cage seemed to be what we wanted, but we wished it to be so delicately balanced and so frictionless that even a tiny fruit-fly would easily turn it. However, if we did away entirely, or almost entirely, with friction, the wheel, once it got started, would go on and on even after the insect had stopped walking. Furthermore, while we were at it, we wanted things fixed so that the wheel would automatically record both the speed and the direction of its turning. As I look back, I do not wonder at the kind, solicitous inquiries of friends concerning the "fly-wheel," and I even forgive the less kind intimations as to "wheels" in my head. The list of failures is a long one, but here is what worked and it is quite simple.

The track where the insect walks is something like an automobile tire with the insect inside of it. It is made of exceedingly thin, transparent celluloid, the "valve" being a tiny, sliding celluloid door for getting the animal in and out. The spokes of the wheel are fine silk threads; the axle, depending on the size of the wheel, is either a needle or the shaft of an almost obsolete thing, a hat pin. Over each end of the axle is an electro-magnet whose strength can be quickly and accurately varied by a rheostat conveniently located in the circuit.

NOW: An insect is put into the wheel, just enough electricity is sent through the magnets to take practically all the weight off of the bearings (a trick suggested to me by Professor R. W. Wood), and the insect can go as rapidly as it pleases but, like Alice and the Red Queen, it never gets anywhere. If it decides to stop, we can decrease the strength of the electric current; this lets the weight press on the bearings and friction stops the wheel.

Since an observer is usually on hand when the apparatus is being used, there really was not much point in having it self-recording but, compared with getting the wheel to work, that was easy, and there is some satisfaction in finishing what one starts out to do. Accordingly, a disk of opaque paper was fitted to the wheel and a series of openings was made in the disk. A photo-electric cell was put back of the disk and a beam of light was directed against its front. Every time an opening passed the beam of light, as the wheel turned, an electric impulse went through the photo-electric cell and worked a pen on a recording tape much as did the cricket treadle already described. The openings were so arranged that the turning wheel "telegraphed" a code message that told exactly what it was doing.

Having the apparatus, there was an obligation to use it and, I confess, this was more like work, although interesting. Not every insect is fit to go in such a wheel. Some sat calmly, as though thinking about something. Others had the will to walk but got tired, for the inside of a freely turning wheel is a trail that has no end. Thus, a yellow-jacket wasp that, in ordinary life, flies much but walks little, started off with an evident intention of getting somewhere in a hurry. For the first 20 minutes it kept steadily going at an average speed of about 9.5 centimeters per second. Then, temperature, light, humidity, and barometric pressure remaining the same, it began slowing up, its average speed in successive five-minute intervals being 8.3; 7.7; 7.4; 7.3; and 6.2 centimeters per second. At the end of the three hours and a half it was still at it but going only 3.9 centimeters per second, having had the longest walk of its life -about two thirds of a mile.



The higher the temperature the faster the milliped walked. "What it all means is another question"

GROUND beetles (Carabidæ) are much more used to walking than are wasps. In fact, they rarely fly. A specimen which Richard Iverson timed for two hours with the wheel in the open laboratory started off with a speed of 5.3 centimeters per second. Its average speeds in 19 of the 20 five-minute intervals for the last hour of the run were: 5.4; 5.3; 5.1; 4.9; 4.8; 5.9; 6.0; 5.9; (Dick took a five-minute rest); 6.0; 6.2; 5.8; 5.7; 6.2, 6 1; 5.5, 5.6; 6.0; 5.2; and 4.3. Apparently it could keep that up longer than we cared to watch and record. Our automatic disk contraption would have been handy in this case.

The créature that best served our purpose was not, strictly speaking, an insect but *Spirobolus marginatus*, the large brown milliped ("thousand-legger") of the late-summer woods. It is heavy enough to turn the wheel without the help of magnets; it is a consistent walker; and there is an absolute fascination in watching the perfect rhythm of those many legs hour after hour. Let us examine the effect of two environmental factors upon its speed of locomotion.

A *Spirobolus* was started off at a temperature of 32.5° C. (90.5°F.); then the box which contained the wheel was gradually cooled to 18° C. (64.4° F.); and finally warmed again to 30° C. This took about four hours and a half, the creature walking most of the time. Distance traveled, together with elapsed time, was electrically recorded on a rapidly moving tape. If you are used to reading graphs, the one on page 271 will clearly tell the story. The dots on the graph indicate the average speed of walking (see left-hand margin) at various temperatures (see bottom margin) and the slightly curved line is that given by the formula noted above when the constants are speed of walking (centimeters per second) equals

$$2.238\,e^{6351\,\frac{(\text{Temp.}\quad 300)}{(300\times\text{Temp.})}}$$

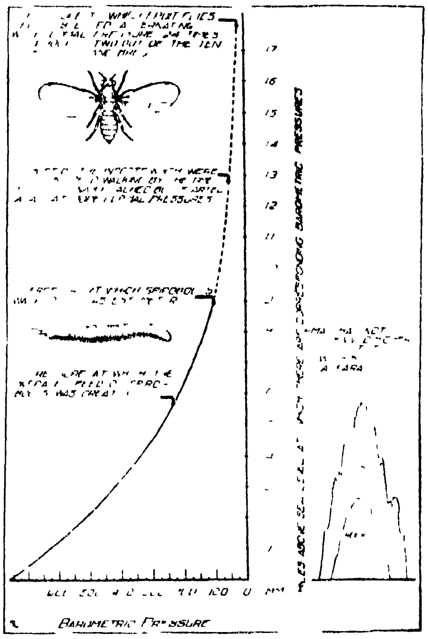
when temperature is given on the "absolute" centigrade scale It is quite evident that "the warmer, the faster." What it all means is another question.

RATHER more startling experiments, perhaps largely because they were in an almost unexplored field, were the effect of changed air pressures, and this requires a bit of comment on the side. At sea level the air above us weighs so much that it balances the weight of a column of mercury about 760 millimeters high; in other words, the barometric pressure is about 760 millimeters at sea level. As we go up in a balloon (mountains are not high enough for present purposes) the pressure decreases, but not in simple proportion to the altitude. "Sounding balloons," carrying recording barometers but not a human being, have attained about 19 miles above sea level. But even that is not high enough for our present purposes. Since we do not know what the air pressure is 30 miles above sea level, about the best we can do is to take a very simple formula which seems to be "in the direction of the truth" even though it is known to be inaccurate. It is that altitude in miles about equals

$$10.33\ \log_{10}\left(\frac{760\ \text{mm}}{\text{Observed Pressure}}\right)$$

It may be simpler to look at the curve in the drawing above which gives, on the bases of known facts and of this formula, altitudes in miles for various barometric pressures.

For this experiment *Spirobolus* was put in a wheel; the wheel was put in a bell-jar; and air was pumped out of or let into the jar according to whether we wished to decrease or increase the atmospheric pressure. It was absurdly easy to give the creature all of the air-pressure thrills of a super-balloon ride to, say, 15 miles above sea level (air pressure of about 27 millimeters) and return in less than three minutes. Of course, since it is well to investigate one factor at a time, temperature, light, and humidity were kept as nearly constant as possible, and for that reason we can speak here of only the effects of air pressure and decreased oxygen supply.



The effect of decreased barometric pressure on several animals tested. The vertical column of numerals has reference to miles above sea level at which there are corresponding barometric pressures. The insect is a much "tougher" organism than the mammalian primate known as *Homo sapiens*

Suppose a man were being treated in this way. Even if the change were made slowly, his gait would be wobbly and his breathing very labored at a pressure of 400 millimeters of mercury, and the aviator Gray died, whether accidentally or not, when it was about 150 millimeters.

Since we wished to time the speed of walking at various pressures, *Spirobolus* was subjected to graded series of them. Observations were made during the first hour at 740, 500, 400, 300, 250, 200, 150, 100, 75, 50, 40, 30, and about 22 millimeters pressure in succession. In order to have a constant degree of humidity and also to prevent drying of the milliped by excessive evaporation, we had water in the jar and, since the vapor pressure of water at ordinary summer temperature is about 22 millimeters, that was as far as we went, and it seemed far enough for the present. At that, there was practically no air left in the jar. Then we came by rather short stages back to normal; then went to 100 and back to normal; and repeated this "round trip" three more times -all in two hours and a half.

Instead of walking more slowly as the air became rarer, *Spirobolus* increased its speed, all of its many legs functioning in absolute rhythm. This increase kept up on the average until the air was about two thirds gone, corresponding to pressures at an altitude of, say, six or seven miles; then it began to slow on the average and stopped (but not for good) when there was practically no pressure left except that of water-vapor. As a matter of fact, however, the fastest one-meter dash that it did was at an air-pressure of only 105 millimeters (representing, say, an altitude of about nine miles), making the meter in 59 seconds or a rate of about 1.7 centimeters per second. Of what stuff are these creatures made, at any rate?

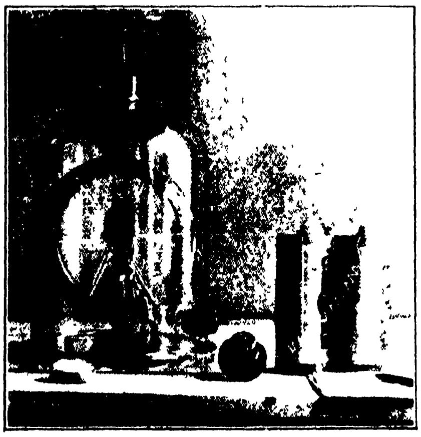
WE are all familiar with the tiny, red-eyed fruit-flies that come about over-ripe bananas and the like. Ten of these flies were put in a bell-jar with water and the air exhausted to the vapor-pressure of water in 90 seconds. The flies stopped moving. Valves in the apparatus were then opened wide and the pressure almost instantly returned to normal. Within four minutes all ten were walking about as though nothing had happened. The same procedure was repeated again and again. After the eighth trial one fly did not walk within seven minutes and I did not wait for him but went on with the one- to three-minute swings from normal to "none" and back again. After the 20th trial only six of the ten stalwarts were walking and I took time out for tea.

After tea we (the flies and I) made four more round trips and then only a male and a female of the original ten were still alive. There seemed no point in pushing the experiment to their death and, besides, I wanted to see if they were really as well and hearty as they seemed to be. So, I put them in a cage with a nice ripe banana, where they started breeding the next day. Careful microscopic examination of their children, grandchildren, and great-grandchildren failed to reveal indications that anything unusual in fruit-fly affairs had happened.

Human endurance would fall so far below that of insects in such a test that no comparison can be made. An express elevator in the Woolworth Building or the dropping of a cage in a deep mine are slow coaches going a short block compared to the ride these flies took 24 times in four hours, but in what follows we tried to reach the limit of even insect endurance—and failed as far as air-pressure is concerned.

It is well known that, in order to produce X rays, the air is almost completely removed from the X-ray tube and then an electric discharge of very high voltage is made to jump the gap between two electrodes in this "vacuum." But the so-called vacuum, while nearly complete, is not entirely so; there are still enough ions left to carry the electricity from one electrode to the other. Furthermore, it is possible, by means of a pump which Mr. Alfred L. Loomis has in his bio-physical laboratory at Tuxedo, to exhaust the tube so completely that the X ray dies out and even 30,000 volts will not force a discharge across the gap. Instead of an air-pressure of about 760 millimeters of mercury, as we have in normal atmosphere at sea level, the pressure now in the tube is of the order of one 10,000th of one millimeter. It is probably lower than the vacuum of interstellar space. What would happen to a "frail" butterfly or bee if subjected to such a vacuum and then suddenly brought back to normal pressures?

THE answer is complicated by a factor already mentioned, one which we found was more important than sudden and great changes in air pressure. This factor is that the pump which removes the air also removes the moisture; and insects which are kept in a pressure much less than the vapor pressure of water would quickly dry up and die of desiccation. Water can not be supplied to them in this apparatus, because some of it would evaporate so quickly that what remains would be frozen to solid ice and, in fact, part of the slowing effect of high vacuum on insects may be due to a marked lowering of their temperature caused by evaporation from their bodies. However, let us see what happened.



The treadmill placed inside a bell jar connected with a vacuum pump

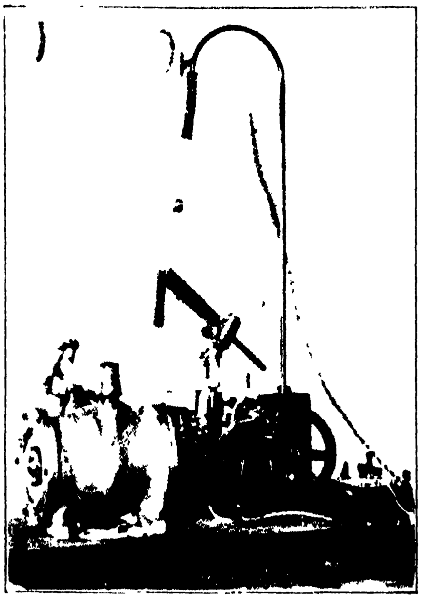
Three small bees belonging to two genera of the sort that live a solitary life, instead of in colonies, two mound-building ants, a beetle related to fireflies, and an immature grasshopper, were put in a tube and the ends of the tube were melted so that it was welded into the apparatus. (Ordinary joints would not hold.) Since moisture would ruin the pump and since moisture was sure to come from the insects, that part of the tube between the insects and the pump was packed in a mixture of solid carbon dioxide and acetone in order to freeze the water out of the air while on its way to the pump.

The pump was started and the next three minutes were busy ones. First the vacuum-tube glow appeared, but before the end of the second minute it had died out, showing that a non-conducting vacuum had been reached. This was held for 60 seconds, a rapidly growing pile of snow in the chilled connection being the moisture sucked out of these "frail" creatures, and then the glass tube was broken at one blow and the insects were returned to normal conditions from their journey into a "complete vacuum." Not one moved then, but two hours later all were active and apparently normal. A little later one of the ants showed some signs of trouble but whether it was due to the vacuum, the drying, or to some more natural cause I do not know. The next day that ant was dead but, when released, the other ant and all of its companions each according to its kind flew, hopped, or walked away.

THE same experiment was tried with a bumble-bee and two kinds of butterflies, except that the insects were in a vacuum of less than one millimeter pressure for four minutes and the extreme of 1/10,000 millimeter was kept up for 90 seconds. In about ten minutes after the tube was broken, instantaneously returning them to normal pressures, the bee and one of the butterflies began to show signs of life. Five minutes later both were walking and the other butterfly was feebly moving its legs and mouth-parts. By the next day the bumble-bee was active as ever but the butterflies had died. Possibly they were unable to withstand the conditions of the experiment, including the excessive drying, and possibly they died from other, more natural causes, but it did not seem necessary to try the experiment again.

There was no longer room for doubt that insects and their near relatives are creatures that can not only exercise vigorously at air-pressures which no man nor any of the animals related to him could survive; creatures that can not only completely recover within a few minutes from sudden and rapidly repeated transfers from normal pressures to almost none and back again; but they are creatures that can survive the most complete vacuum that man can produce with exceptionally perfect apparatus. How do they do it; why can they do it?

All that we can say is that insects seem to be better made than we are. They have invaded almost every bit of the livable world, including hot springs and the highest mountains, the Arctic and the tropics, in water and on water, underground and above ground, in plants and animals and on them. Only the ocean is avoided by them. Their structure and mode of living have stood the test of time practically unchanged since the Carboniferous period. Possibly Maeterlinck was right when he called them "beings so incomparably better armed and endowed than ourselves, concentrations of energy and activity in which we divine our most mysterious foes, the rivals of our last hours and perhaps our successors." On the other hand, as has been pointed out in "The Friendly Insects" (*Natural History*, Vol. XXVI, p. 147), relatively few kinds of insects seriously injure us and we owe much to many kinds. Possibly, with increased knowledge of insect habits, we may be able to swing the balance still more in our favor.



The high vacuum pump at the Loomis Laboratory. See the text

WHAT good are such experiments as these? Possibly collecting interesting information about the masterpieces of Creation is of no greater value than collecting human masterpieces of art; and possibly writing about Nature is no more useful than writing music; but, until some one is wise enough to be able to predict the worth of any bit of pure (as contrasted with "applied") science, we can at least say that it "amuses" those who do it and interests many who read about it. "Pure" science is science which has not yet been applied.

The Largest American-Made Telescope Mirror

READERS who are devoted to to science and the arts doubtless will recall that, in January, 1928, much publicity was accorded by the scientific and daily press to the successful casting of a two-ton disk of optical glass at the United States Bureau of Standards in Washington.

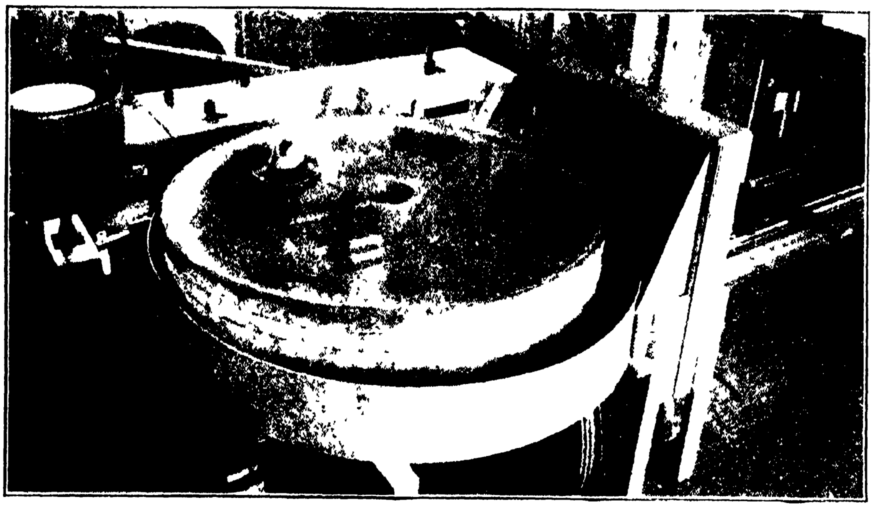


Figure 1, Above: **The raw glass disk of the 69-inch mirror. The geometrical pattern on its edge is due to the bricks of the underground mold**

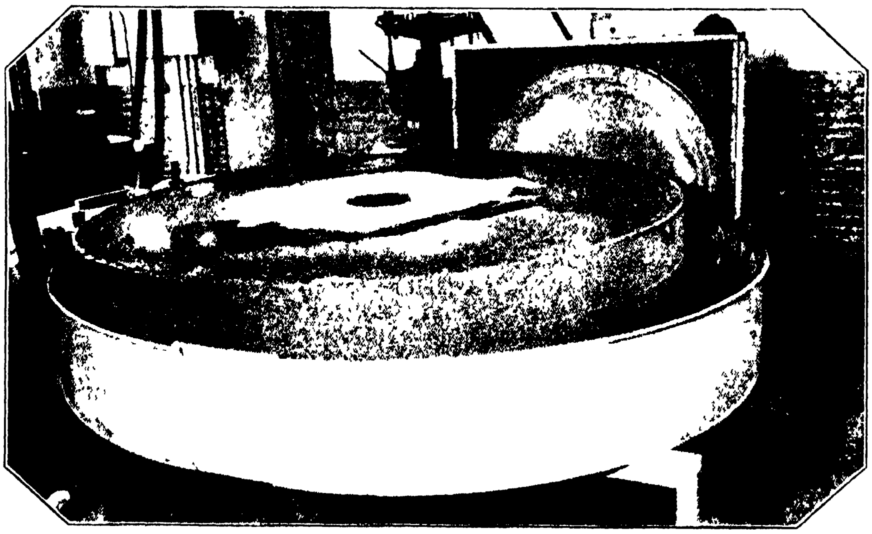


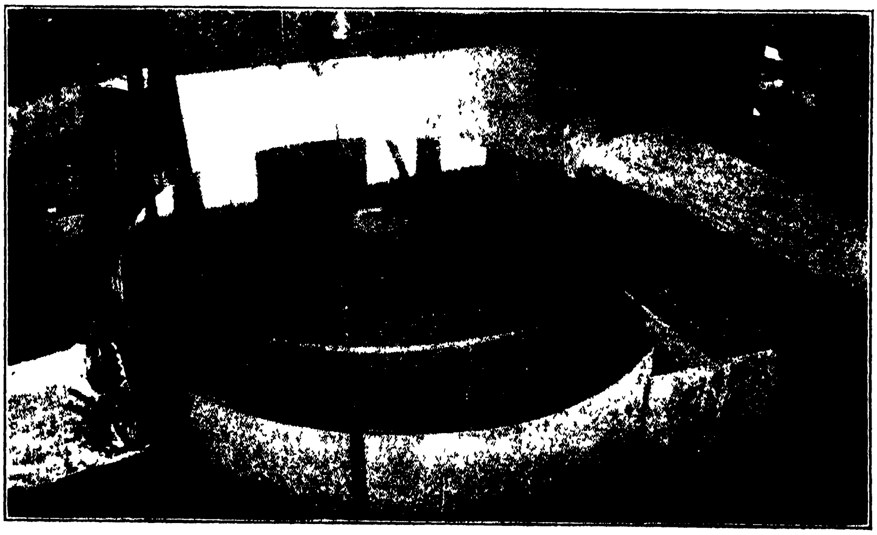
Figure 2, Right: **Rough grinding the edge with water and emery (note pot at right, on the floor) as the disk is slowly revolved**

This disk, 71 inches in diameter and 12½ inches thick, had been poured in May of the previous year. The glass reached the mold at 2500 degrees Fahrenheit, was securely covered (the mold itself was in an insulated pit beneath the floor) and permitted to cool within a week to 1100 degrees Fahrenheit. It was held at that temperature four days, then cooled 4½ degrees per day until it reached 860 degrees, was held at constant temperature 45 days for annealing, and then allowed very gradually to cool to outside temperature, which required 130 days

Only then might, the covering be removed to ascertain whether the disk were broken and worthless or perfect. Dramatic moment! Some wag said that, as the decisive time approached, some of the anxious spectators nearly died of heart failure, but the disk came out uncracked. This was the first large American telescope disk ever cast and its successful completion rightly put a feather in the cap of the Bureau of Standards, particularly of Dr. A. N. Finn, the glass technologist at the Bureau. Optical tests for strains and symmetry of annealing indicated that the disk was optically as well as physically a success, and the whole proceeding thus constituted the beginning of a sort of declaration of American optical independence.

The disk was shipped to J. W. Fecker of Pittsburgh, the successor to the late John A. Brashear whose fame as a maker of large telescope mirrors is a tradition. The sequence of six recent progress photographs reproduced in the present pages was kindly furnished by Mr. Fecker, who with his men has done the further work which they show.

Figure 3, Below: **The edge has been ground and the back surface ground and polished approximately flat. The disk is ready to be turned over and ground to thickness, preparatory to grinding the concave curve in the reverse side**



In Figure 2 the glass is slowly revolving while a disk of iron bears steadily against its edge, with wet abrasive doing the work of removing the irregularities. Figures 3 and 4 are sufficiently explained in the legends. In Figure 5 the disk, now reduced to $9\frac{5}{16}$ inches thick, has been ground to a concave (approximately spherical) curve having a depth of 0.95 inch, and less than one thousandth of an inch will be removed in all subsequent operations.

Apparently, then, the job is about complete. But is it? "In its present state," Mr. Fecker writes, "the mirror is about 20 percent completed." It is this last thousandth of an inch which contains most of the real grief in making a telescope mirror.

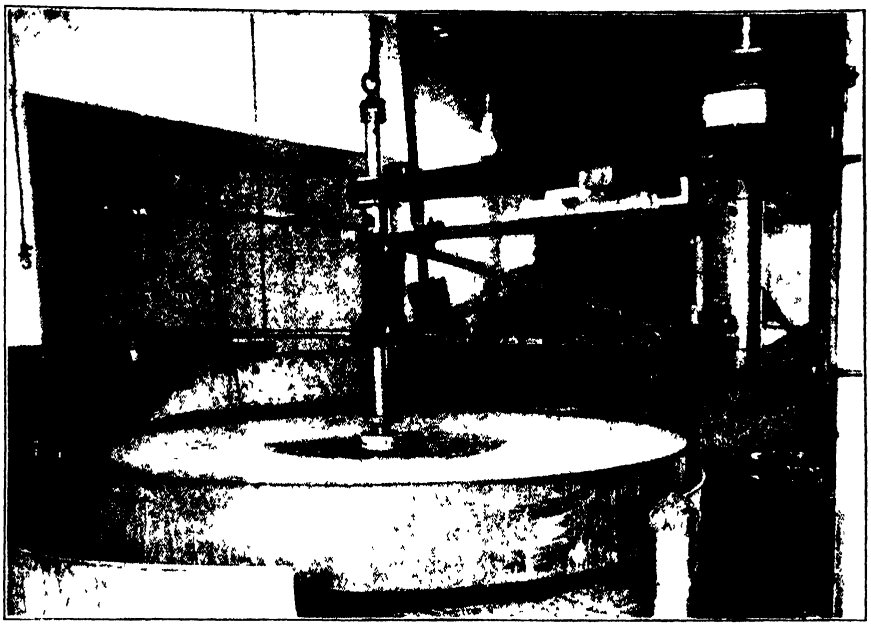


Figure 4, Above: **Grinding the hole true and concentric with the periphery of the mirror. As the disk slowly rotates the vertical, adjustable (note arm), revolving tool, belt driven, enlarges the hole**

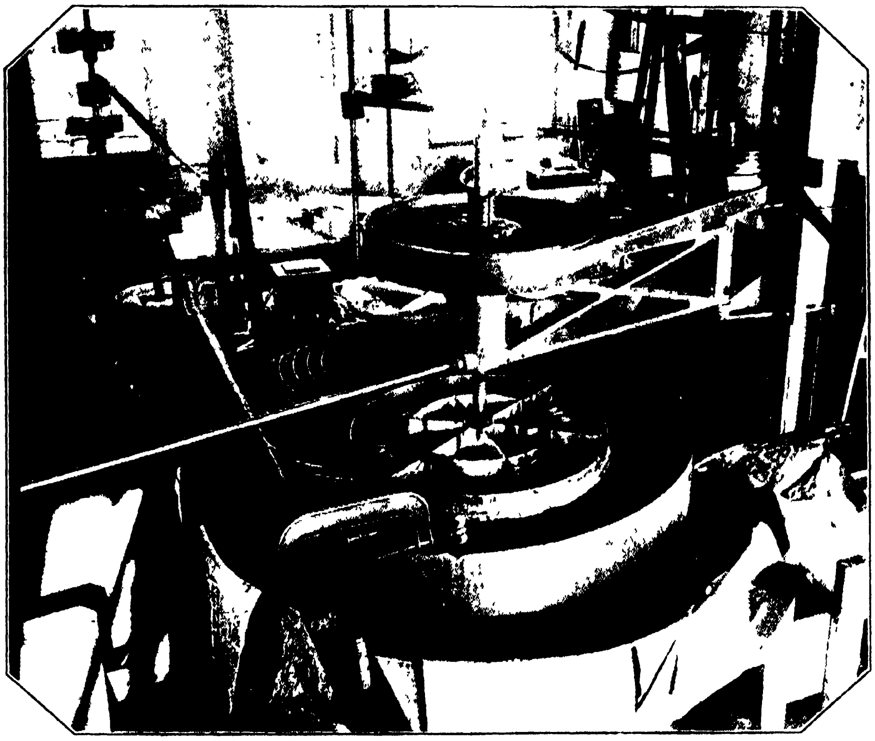


Figure 5, Left: **Polishing the concave surface of the mirror, using a pitch polisher and rouge abrasive. This brings the mirror to approximate spherical form ready for final delicate correction**

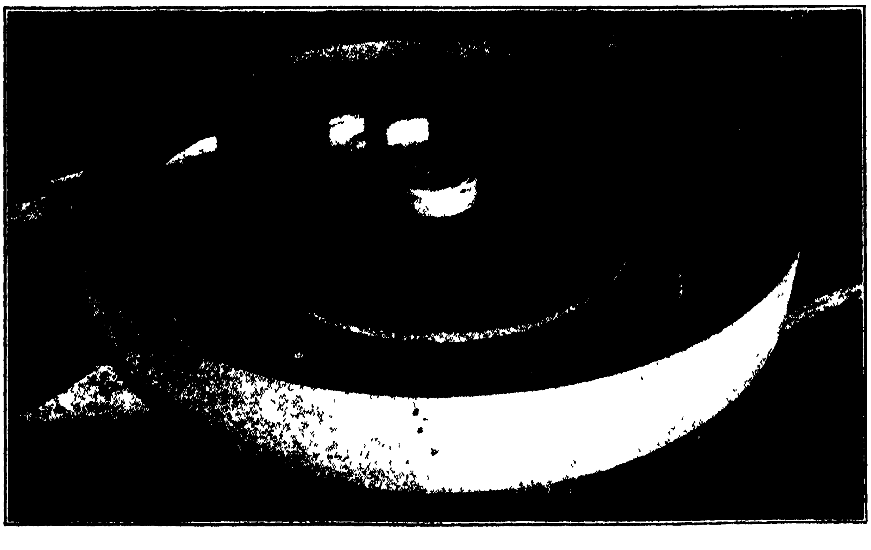


Figure 6, Below: **Ground and polished on both sides, ready to be put into its metal backing or "cell," removed to another machine in the constant temperature room underground and given final correction or "figuring"**

Even a thousandth of an inch is an extremely rough, coarse measurement in this work and a millionth of an inch is much closer to Mr. Fecker's final criterion of perfection. The degree of accuracy required by the purchaser in this case was one tenth of a wavelength of yellow light, or one 500,000th of an inch. In large work of this kind it is the practice to work within a specified tolerance, such as this, but Mr. Fecker carries the refinement to a still higher degree of accuracy. This final process, call "figuring," usually requires endless hours of the most skilled retouching, all performed underground in a constant temperature.

It is hoped that some time in 1931 the finished mirror will be functioning in the large telescope at Ohio Wesleyan University, which was made possible by the life savings of the late Hiram Mills Perkins and his wife Caroline Barkdal Perkins, the donors.—*A. G. I.*

View of St. Helens, at left, showing a group of mid-stream diversion dykes which formed a deep-water channel at St. Helens where once broad marshes prevented ships from landing

The Development of the Columbia River

By CHARLES F. A. MANN

AFTER over a half century of incessant effort by the citizens of Multnomah County and Portland, Oregon, assisted by United States Army Engineers, toward the establishment of a deep channel in the 110-mile stretch of the Columbia River that lies between Oregon's famous port and the Pacific at Astoria, the final and most important chapter of all is about to be written down - that of scraping off the last five feet of river bottom in the present 30 by 300-foot channel, in order that a deep-water canal 35 feet deep and 500 feet wide will be a stable part of the Columbia River.

Word reached residents along the lower Columbia late in 1929 that the Board of Army Engineers had approved and recommended the project to Congress, involving an initial expenditure of only 1,366,000 dollars with an annual maintenance charge of 665,000 dollars. Five feet does not seem much, but when one realizes that 85 percent of all imports of the Pacific Coast ports move in ships of greater draft than can be cared for in the present 30-foot channel, the importance is at once appreciated. Portland, together with its neighboring Columbia River ports of Vancouver, Washington; St. Helens and Rainier, Oregon; Kalama and Longview, Washington, draining vast quantities of lumber, paper, pulp, and fruit into the markets of the world—presents the paradox of a great seaport being able to export but do little importing.

THE Columbia River ranks as one of the great rivers of the world, draining some 300,000 square miles of territory in seven states and British Columbia, which is a region of heavy precipitation. It flows from glacial headwaters in the remote Columbia ice fields in north central British Columbia for 1200 miles to the Pacific.

Because of its gigantic proportions, the development of the Columbia for power and navigation, and use of its waters for irrigation, has been very slow. The great interior stretches of the river flow through vast, sparsely inhabited arid plains and past weird rocky cliffs where once countless lava flows and uplifts tore gashes and even changed the course of the river entirely. There is approximately 8,000,000 horsepower of primary and double that amount of secondary, or summer hydroelectric power available in the Columbia River. Only in the fall of 1929 were plans made for the first power plant ever to be placed on the river. It will be a 100,000 horsepower plant at Priest Rapids, in central Washington.

Because of its glacial origin, the Columbia carries vast quantities of sharp sand in its waters. In addition to this, when the hot summer sun melts the glaciers in the Columbia ice fields each year, the river floods with unusual rapidity, raising the level from 20 to 75 feet in various parts of its course. With a normal flow of about 70,000 cubic feet per second the river rises at certain times to a maximum of 1,400,000 cubic feet per second. Thus two great problems confront engineers who set out to conquer the river: silting and flooding in peculiar combination.

Scarcely 30 miles above Portland—140 miles inland from the ocean—the Columbia takes its last plunge over the Bridge of the Gods practically to tidewater. From there on, the river, known as the Lower Columbia, changes its character. It becomes wide, often sluggish, with shifting channels and innumerable sandbars. Rolling, green hills and fertile river plains in the wide lower river valley form the banks. It is in these quiet waters that the people of Portland and the lesser ports are directly interested.

Long ago navigation on the upper river, above Portland, gave way to the parallel railroad tracks on each bank, which are not affected by floods or silt and need fear no rapids, yet are able to take advantage of the matchless grade through the mountains that never is greater than 0.2 percent all the way from Spokane to Portland. This factor, together with the limitless possibilities of growth in the tributary area of Portland, long ago made one vital factor of great importance to the citizens of Oregon's metropolis: to make the Columbia River into a navigable channel. In final terms their problem was about as follows:

1. To get a deepwater channel to the Pacific.
2. To create a deep harbor in the shallow Willamette River, on the banks of which the city of Portland rises, 12 miles in from the Willamette's confluence with the Columbia.
3. To build two jetties at the mouth of the Columbia in order that the river might carry its silt far to sea, leaving ample depths over the bar at all tides.
4. To keep all bridges high above the Portland harbor and permit nothing but suspension spans with at least 200 feet clearance over the Columbia.

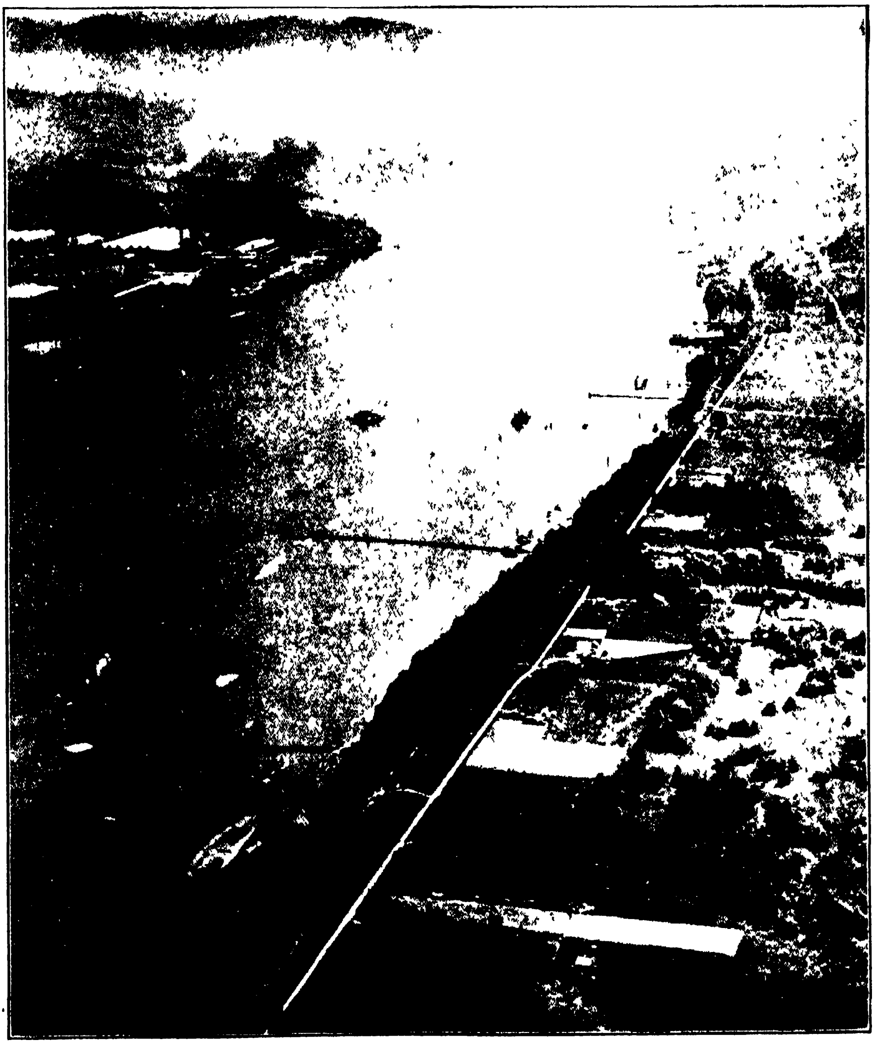
FIRST efforts by Portland citizens to get a deep channel in the Columbia began more than half a century ago. In order to clarify the method of carrying out the long series of river improvements, it is well to divide it into sections. The first section concerns the work of the Engineer Corps, United States Army, which has complete charge of the Columbia from its mouth to its confluence with the Willamette River. The second concerns the work of the citizens of Portland and Multnomah County, that of developing Portland Harbor without financial assistance from the Government through the Port of Portland Commission, and the development of public terminals through the Portland Commission of Public Docks. To the end of 1928, the United States Government had spent about 16,000,000 dollars on the two jetties at the Columbia's mouth, and 11,000,000 dollars on the 100-mile stretch of the Columbia River; the city of Portland had spent approximately 25,000,000 dollars divided about equally between harbor development and a public terminals system.

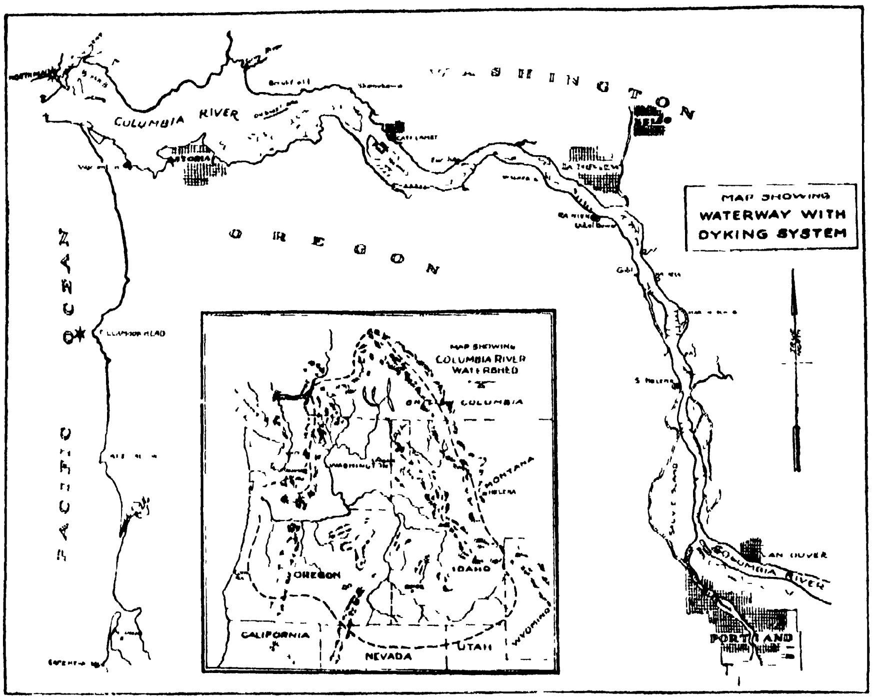
In the original state of the river, a minimum depth of about 15 feet was found, and around 20 feet at the Columbia Bar at the river's mouth. When work was first started by the Government a half century ago, the first problem to be solved was that of making the river scour its own bed free over the bar. The original plan for these jetties was first approved by the Government in 1884, but it was not until a quarter of a century later that they were finished. The south jetty is seven miles long and the north jetty two and a half. These have effectively changed the channel over the bar to a depth of 46 feet for a width of about 2500 feet and 40 feet for about 7000 feet width at mean low water. The original depths of the river were from 19 to 21 feet over a width of six miles.

In the 100-mile stretch from Portland to Astoria, the Columbia develops shoals in about 25 places after the annual freshet in June. These are known as bars and, between them, deep pockets of safe water are found. So regular are these bars that year after year they are found in exactly the same places and after being measured are attacked by dredges and pumped away.

Ever since the long line of surveys was begun on the lower Columbia in 1878, the plan has been to make the river scour its own bars free of silt, the deposit of which varies from three to twelve feet each season, in exactly the same way as the big jetties at the mouth do. Accordingly, the primary problems of the Army engineers were reduced to two: dyke construction and supplementary dredging where dykes would not do the job.

BY watching the river closely after each flood, they have found where the shoaling takes place. As a result of this, more than 70 dykes projecting into the river at various angles have been built, which act as a contraction to the stream flow and keep the mass of mud and silt moving along the bottom. Supplementing this, after each flood from June to October, a fleet of dredges attacks the bars and brings them back to normal depth. The Portland Port Commission lends the War Department two dredges for a period of three months each year, the government paying nothing but operating expenses, to assist the regular Army dredges in speedily bringing back the proper depths before the


Three new dykes at Ranier, Oregon, at wide part of river where silting takes place. Notice how sand has been deposited on downstream side of dykes



deep draft grain ships begin to move in October. This accounts for the abnormal rush to bring the channel back to proper depths that takes place each summer. The Willamette River does not silt in summer, but during heavy rains, it floods vast quantities of mud down from its valleys, which must be removed. Silting in the Columbia amounts to about 5,000,000 cubic yards per year.

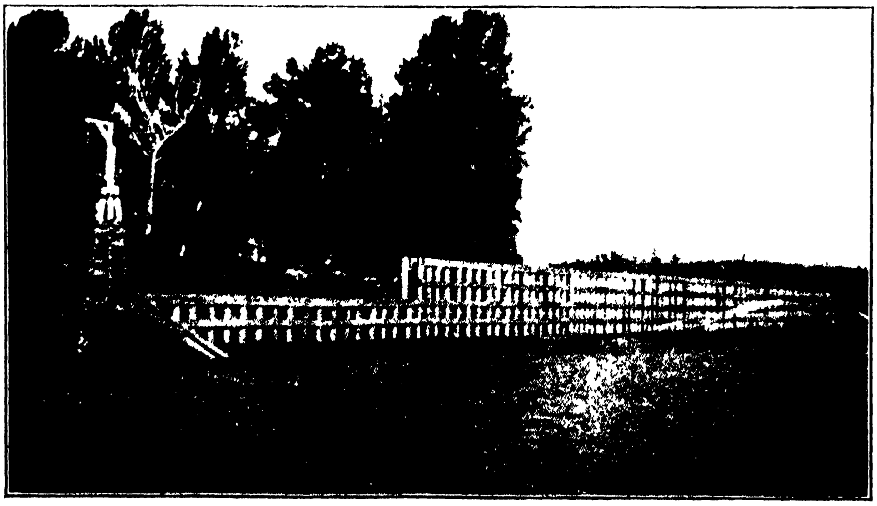
After years of effort, the effect of the permeable dykes has become apparent. The channel is now stabilized and the success of the timber and rock wing dyking system has been proved. The entire project is a part of successive projects for 20, 25, and 30-foot depths approved by Congress in acts of 1892, 1902, 1905, 1913, and the foundation work of the 35-foot depth project about to be started, in 1919. With faster and deeper ships, increased dyking has had to be done to compensate for the increased cross-sectioned flow incident to dyke construction of earlier dates which deepened the channel.

In order to execute the 35-foot project, about 18,000,000 cubic yards of silt will have to be removed. In addition, 18 new dykes will have to be built and 28 extended farther into the river, amounting to 41.7 miles of Columbia channel and 11.5 miles in the Willamette. The annual appropriation of 665,000 dollars will serve to dredge away 7,000,000 cubic yards of silt and to repair dykes.

At Portland, we find the oldest quasi-public organization in the northwest, the Port of Portland Commission, at work with a fleet of four dredges, moving millions of yards of mud out of the Willamette, building its famous Swan Island Airport in the middle of its harbor out of waste silt from its dredges, filling in valuable real estate areas in the harbor, operating drydocks and towboats, and in sole charge of the entire harbor, without governmental aid in any form. Organized in 1891, the Port Commission began dredging away on its harbor, then mainly a muddy puddle between the two halves of the city. One old steam pipeline dredge—the famous *Portland*—worked 30 years at the task. Four others, ending with the 2000 horsepower twin-turbine steam dredge *Tualatin* and the giant *Clackamas*, a 3100 horsepower Diesel-electric dredge of tremendous capacity, were built. The *Clackamas* was the last dredge built by the Commission and, at the time of her building in 1925, was the most powerful in the world. She is capable of moving 20,000 cubic yards per day at a cost of about three cents per yard, and cost 850,000 dollars to build. During the two years in which the Swan Island Channel was changed to the west side of Swan Island and the famous airport built out of the waste from the dredges, the Port Commission dredges moved 39,000,000 cubic yards of material with an over-all cost of about 2,500,000 dollars. The real estate obtained by filling tide lands reduced the net cost of the entire project and gave the Commission an airport, a yacht harbor, and a new channel, all for less than 800,000 dollars! This still ranks as one of the most important dredging projects in the world.

With the last and most important step of all about to be taken, that of the 35 by 500 foot channel to the sea, the efforts of 50 years will at last bear their best fruits. Probably no more important piece of engineering has been done in this country than the building of a fine inland seaport on the erratic Columbia. With the hinterland yet comparatively untouched, and an enthusiastic group of boosters besieging Congress for 350,000,000 dollars to irrigate 2,000,000 acres of the Columbia Basin, the waterway will grow in importance as the years pass. Credit for the two big divisions of Columbia River development goes to Colonel G. R. Lukesh, of the Army Engineers at Portland, and James H. Pohlemus, Manager and Chief Engineer of Portland's famous Port Commission.

Another phase of the work, although not immediately concerned with channel development, is the vital problem of bridges in which approximately 50,000,000 dollars have been invested. Eight large spans cross the Willamette and two cross the Columbia carrying rail and highway traffic northward from Portland into Washington. A 6,000,000-dollar cantilever span across the Columbia between Longview and Ranier was opened in January, 1930; and a 5,000,000-dollar suspension span has been planned to cross Portland Harbor at St. Johns.



Dyke on Washington shore, showing type of construction. Channel marker on end of dyke on tower. River is low; high-water in June nearly covers the dyke

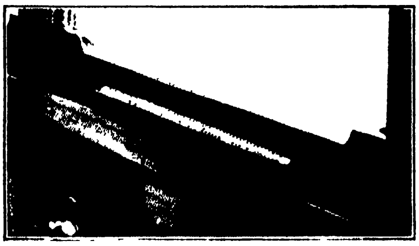
A Reclining Chair Night Coach

WHEN a person has to travel only part of the night, it hardly pays to take a berth in a sleeping car; some travelers cannot afford even the luxury of an upper berth. To all such, a new type of car has been introduced by the Baltimore & Ohio Railroad Company for their night trains between New York and Washington. These cars were built in the Mount Clare shops, Baltimore, Maryland. "Twin seats" in day coaches are in use on other railroads, but these new cars have many points of novelty.

THE exterior of the car shows no change, but in the interior there are many departures from normal practice. By means of cranks, each seat can be inclined independently. The arm-rests of the reclining seats are of sponge rubber composition, soft and comfortable. The middle armrests are collapsible and disappearing so they can be removed if desired, to allow children to lie down. Foot-rests are also provided, adjusted to the proper angle so that when the seats are in a reclining position, the posture of the occupant is conducive to rest. Thermostatic control is provided on each side of the car to insure even temperature throughout, and in addition there are ceiling and window ventilators. The decorations are plain and the car is finished in "living-room" style. In addition to ceiling lights, small individual night lights are provided so that those who wish to read may do so. There are separate smoking rooms for men and women, with comfortable arm chairs. The great novelty is the lunch room at one end, where simple refreshments can be obtained at all times during the long and wearisome night.

All photos courtesy Baltimore and Ohio Railroad

Each seat can be inclined independently by manipulating the cranks (insert). Windows have ventilators and a night light is on the side wall over every other seat

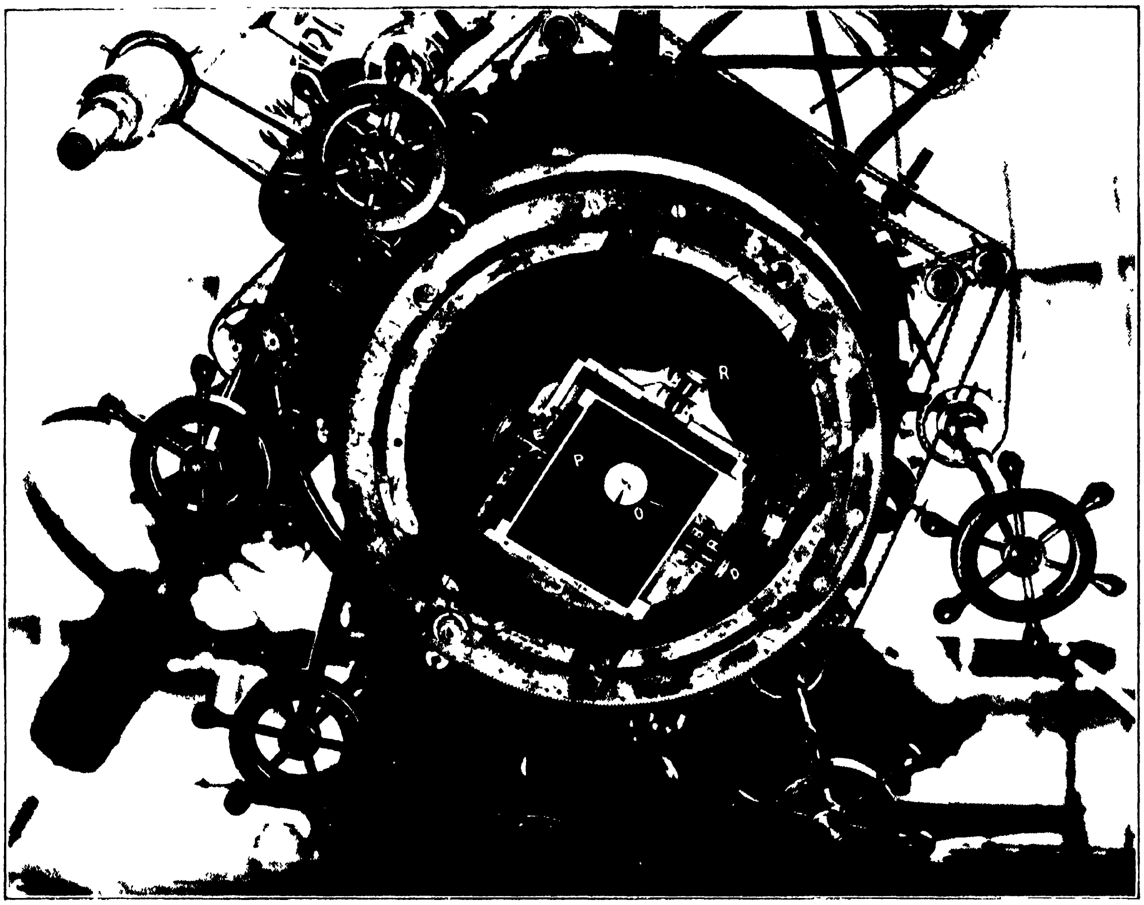


The window ventilator is a novelty. The air filters in through screens which arrest the cinders. Car windows are notoriously obstinate and here is the solution. The chair position crank is seen below

Above: **The foot rests are adjusted to the proper angle so that when the seats are in a reclining position the posture is most rest producing**

Left: **Women need no longer "bootleg" smokes, for a comfortable compartment with real chairs is provided for their use**

Right: **This is not a "diner" or a "broiler" but it is a real lunch counter, where beverages, fruit, and sandwiches can be obtained**



Courtesy Yerkes Observatory, also Astrophysical Journal (Vol. 42 page [illegible])

Figure 1: **Professor Schlesinger's occulting disk or rotating sector invention attached to the 40-inch Yerkes refractor, for use in star distance measurement. The nearly square central object is the 8 by 10 photographic plate holder. O is the disk adjusted to a V-shaped opening (small object at center of disk is an adjusting wingnut.) P is the prism described in the text, and E the guiding eyepiece with crossed spider webs inside. R and D are the two guiding screws**

Measuring the Distance to the Stars

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

SIR ROBERT BALL, who illuminated his admirable lectures with recurrent flashes of his native Irish wit, used sometimes to say, "Astronomy consists of sitting up all night and doing arithmetic all day." No truer picture of the life of the working astronomer was ever compressed into a sentence. All that need be said in addition is that some astronomers specialize in the sitting up, some on the arithmetic, while some divide their energy between the two.

An excellent example of the third sort of work is found in the measurement of the distances of the stars. This has become in recent times distinctly an American field of work and may well claim our attention for a few moments. The principle involved is the simplest. Look out across the room through a window at the world without, then move your head a few inches from side to side. As you do so the window bars will seem to shift to the right as you move to the left, and *vice versa*. It is exactly such a shift of nearer objects, compared with those at a distance, which we use to measure the distances of the planets and the stars, only we call it by the Greek name of "parallax." Obviously, the nearer one sits to the window the more the window bars will seem to move across the landscape (for the same motion of one's head) and, if one can measure the apparent shift, the simplest sort of geometry gives their distance. Exactly the same principle is used in the range finders which are so important in military and naval gunnery.

TO apply this principle astronomically we must have two things: a shifting base moving by known distances, and a distant background against which we can measure the parallactic shift. When we are working on the moon or the nearer planets we change our base simply by making observations from different parts of the earth, or by the cheaper process of letting the rotation of our planet carry us around it. When we must deal with the stars we need a far longer base line. Fortunately we have one, provided by the earth's motion in its orbit, which takes us alternately 93,000,000 miles on one side of the sun and on the other, and so gives us a base of double this length. Even with this long base the parallactic shift is measureable only for a small minority of the stars. The rest are so far distant that their displacement is imperceptible.

This is no unmixed evil, for we may employ the multitude of faint stars which cloud the heavens as the background, the standard of reference; which is the other prime necessity of the method. Theoretically it is not quite an ideal standard, for even these remote stars must show a small parallactic shift compared with an absolutely fixed background. But, practically, this makes no trouble, for we have means, based largely on the sun's motion in space, of finding the average amount of this tiny shift and can then allow for it.

When it comes to the application of these principles to the actual measurement of star distances we meet with various difficulties. The first is that the stars do not stay still to exhibit their annual shift, but move across the heavens. By extending our observations over two or three years, however, we can easily find out the rate of this "proper motion" for each star and allow for it. More serious is the fact that the shift due to parallax is very small, so that our observations must be extremely accurate. This difficulty again has been fairly well overcome by the use of large telescopes and, above all, by the photographic method of observation.

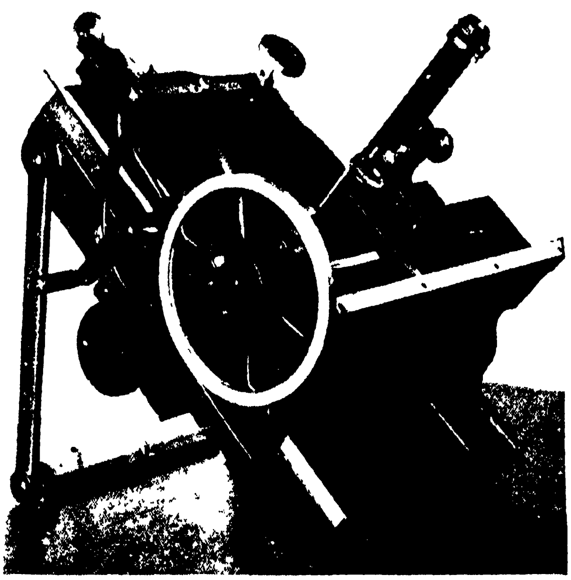
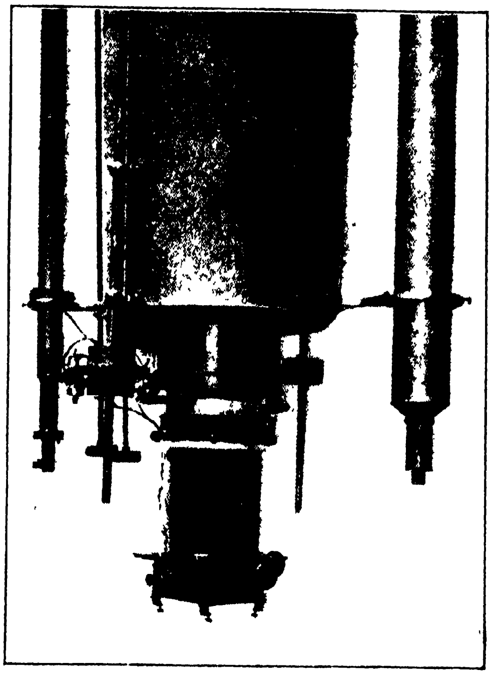


Figure 2, Right: Gaertner machine for measuring parallex plates. A microscope, movably mounted above the plate on a very accurate, horizontal low-pitch screw, is spotted over the star's image, with the aid of its cross hairs. The accurately divided index head at end of screw facilitates measurement to 1/25,000 inch

Courtesy Yerkes Observatory

Figure 3, Below: Double slide plate holder of the 26 - inch refractor at Leander McCormick Observatory with which Professor Mitchell's work was performed. Note small guiding eyepiece at left and guiding screws at right

Courtesy Prof S A Mitchell



ONE of the most unexpected discoveries of modern precise astronomy was that it is possible to make more accurate observations with a given telescope by photographing the stars and measuring the positions of their images on the plates than by measuring the stars directly with a micrometer attached to the telescope. Until the thing was actually tried no one had any idea how precisely the photographic film preserves the record of the position of the images which impress themselves upon it. In ordinary modern practice the average error of position of a single star image is less than a 10,000th part of an inch. Considering the vicissitudes through which the gelatine film has gone during the processes of development, fixation, and drying, this is really extraordinary.

However accurately the plate records the positions of the star images, it must be measured under the microscope, employing some form of micrometric device (for example, as in Figure 2), and it may still seem strange that this two-stage process yields better results than does the micrometer directly applied to the telescope. The most probable explanation is that, owing to the irregularities of atmospheric refraction, the star images in the telescope are continually oscillating and dancing about. In visual observation the observer sets his spider thread on the images and catches them at some one moment. The plate automatically averages the effect of the oscillations of the image during the whole length of the exposure (usually several minutes) and thus gains a considerable advantage. When it comes to measuring the positions of several stars in the same field the photograph has the still greater advantage that its record is simultaneous for all, while the visual observations must be successive and are subject to different errors in each case.

Photographs, therefore, have quite ousted all other methods in parallax work, but the observer is only at the beginning of his troubles when he has set up his telescope and got his lenses into proper adjustment. In the first place his instrument should follow the diurnal motion of the stars in the heavens so perfectly that the image of a given star throughout the whole time of the exposure falls exactly on the same spot upon the plate. Even the best driving clocks do not quite meet this severe requirement, and of course they can not follow at all the irregular motions of the images caused by refraction. To meet this need the parallax observer has the plate holder mounted on the telescope in such a way that it can be moved up and down or right and left by two delicate screws. (Figure 1 at D and R; also Figure 3.) Just outside the plate holder and clamped to it is an eyepiece (E, Figure 1), adjustable in such a fashion that the observer may bring into it the image of some faint star. Before he begins his exposure he brings this star on the cross hairs of the eyepiece. Then, watching with the eye of a hawk, he notes the slightest deviation of this image and brings it back by turning one or both of the screws which move plate holder and eyepiece together. An experienced observer in this way may get rid of most of the "errors of guiding" which otherwise might vitiate the positions of his star images. As a result of this care the images will all be small, clean and round. If by any mishap they are not, the plate will be rejected and not measured.

TO get good images, however, we need not only careful guiding but correct exposure. Under-exposed images are gray and diffuse; over-exposed large, fuzzy, and ill-defined- and neither sort can be measured accurately. When the star whose parallax we are seeking is faint, this causes no extra trouble. A trial plate or two shows what length of exposure is necessary to get good images of this "parallax star," and among the other stars which appear on the plate it is practically always possible to find enough of about the same brightness to serve as the "comparison stars" which furnish the requisite background.

But the parallax star may be a bright one -perhaps even Sirius itself --while the only available comparison stars are a hundred or even a thousand

Photo by Dr. James Stokley Science Service

Professor Frank Schlesinger, Director of Yale Observatory, whose parallax work was done at Yerkes and Allegheny Observatories

times fainter. Obviously, some means must be found to cut down the light of the one without obscuring the others. This is usually done by the aid of an "occulting disk" an inch or so in diameter (Figure 1, O). This consists of two parts which can be set so as to leave a narrow open sector of any desired width from 1 degree to 180, while blocking out the rest of the circumference. This disk is mounted close to the front of the part of the plate where the image of the parallax star falls and is rotated rapidly by a tiny motor or by clockwork. If the opening in the sector covers only 1/50th of the circumference, the parallax star will be given intermittent exposures which will total 1/50th that given the fainter comparison stars which receive a continuous exposure.

WITH this apparatus the image of even a very bright star may be reduced to apparent equality with those of its faint neighbors without losing the advantage resulting from the averaging effect of a large number of exposures under different conditions of trembling of the images. This method has been completely successful, with the result that observations of stars as bright as Sirius made with its aid are found to be as accurate as those of faint stars which do not need it.

Still another danger, and the most subtle, remains. The images of the stars are raised in the heavens by refraction, and more for white stars than for red ones (by the same influence which produces the "green flash" at sunset). If our parallax star and comparison stars are not of the same color (as very often happens) this will shift the one relatively to the other. So long as this spurious shift is always in the same direction and of the same amount it will not trouble the parallax observer, but if it is in different directions at the same time of his different observations it may become confused with the true parallactic shift in such a way as to vitiate his results. To be safe, therefore, he must observe any given star always when it is in the same position in the sky, preferably on the meridian, so that the error due to refraction may always be the same.

When all these precautions are taken, a set of from 12 to 20 photographs made at the proper times during an interval of two or three years, will give a determination of the parallax with the probable error less than 0″.01, which exceeds in precision any other angular measurement.

Parallax work is a strenuous occupation. To get the shift in one direction the stars must be photographed in the evening as soon as it is really dark which is easy; but every such plate must be matched with one showing the opposite shift taken at some other time of the year and in the morning hours just before dawn. To carry on the careful work of precise "guiding" without a moment's relaxation of the tension through these weary hours is "sitting up" with a vengeance, even if the observer has left the instrument to another worker during the middle of the night and sought a well deserved rest- and it is rarely that the size of an observatory staff permits such a relief.

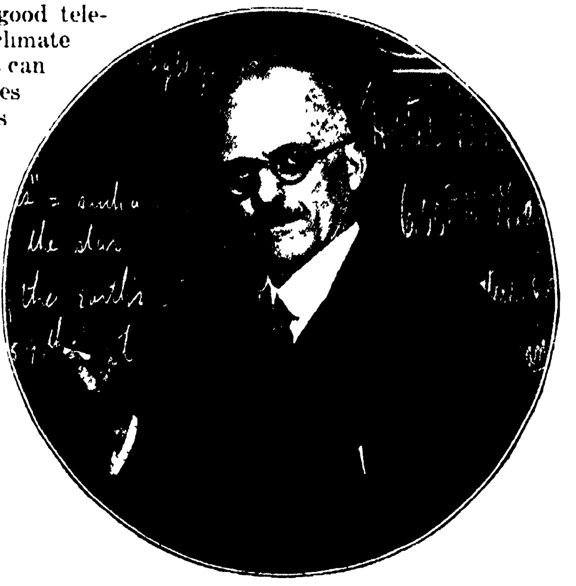
Measuring the plates, after they have been developed and passed as fit for it, is a job for the daytime and for a good light, and consumes a great deal of time. Indeed, one good telescope in a fairly favorable climate and with assiduous observers can secure plates two or three times as fast as these observers could work them up. Fortunately the measurement, like most routine work, can be entrusted to assistants and this is true *a fortiori* of the computations, which are simple but interminable when thousands of plates have to be discussed.

The pioneer of this photographic method was the great Dutch astronomer Kapteyn, who first pointed out the importance of accurate guiding and the way to avoid the errors due to refraction. The methods which are at present employed are mainly due to Schlesinger of Yale, who first used the rotating disk upon bright stars and devised the very convenient methods of calculation which are now employed by almost all workers in the field.

Most of these workers are Americans. First in productivity is Professor Mitchell, Director of the Leander McCormick Observatory of the University of Virginia, who recently has been the guest of his colleagues at other observatories in celebration of his completion of determinations of parallax for no less than a thousand stars! (See page 247.) This record is the more noteworthy since it comes from an observatory possessing a telescope of moderate size, as great instruments now go, and very modest resources. Moreover, the telescope is a visual one and therefore slow in photographic work. Only the persistent devotion for a long term of years of the director and a loyal corps of colleagues could have secured this remarkable result.

NEXT in order comes the Allegheny Observatory where, at first under Professor Schlesinger and later under Professor Curtis, more than 850 parallaxes have been determined. Smaller but very considerable lists, each about 300, have been observed at Mount Wilson, Yerkes, Greenwich, and the Sproul Observatory of Swarthmore College. The promising and almost untouched field of the southern hemisphere is now being worked both at the South African station established for the purpose by Yale under the direction of the veteran Schlesinger and at the Cape Observatory.

Arduous as the work is, and dull as some parts of it may seem to one who merely reads about them, it has a curious fascination.- *At anchor, off Mytilene.*



Dr. H. D. Curtis, Director of Allegheny Observatory at Pittsburgh, who also has measured many star distances and made inventions

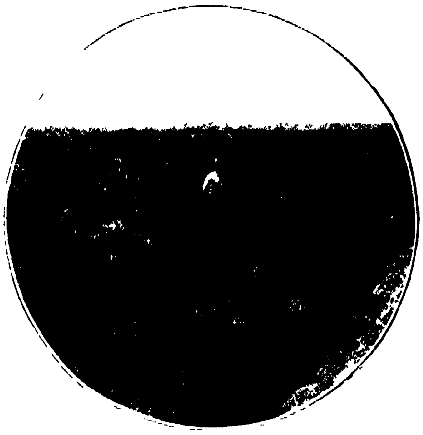
Where once were the worthless tule marshes along the Sacramento River, are now found prosperous farms, luxuriant orchards, and beautiful homes wealth for everybody everywhere

Courtesy *Pictorial California*

Marsh Delta Lands Become Rich Farms

ONE of the most fertile regions in California is the Delta area (usually called the "Delta lands") in northern California, just a few miles west of Sacramento, the capital city. The tule marshes along the Sacramento River were long considered worthless but have been developed in recent years into most fertile farm and orchard land. Until the engineers constructed levees, drainage canals, pumping plants, and other flood protection, the Sacramento and San Joaquin Rivers spread out over the entire area during annual spring floods, depositing new layers of silt. Water for irrigation now comes from the rivers and the surplus water is drained and pumped back into them. Soil rich with the humus of centuries, abundant water, and a splendid climate all unite to make this one of the most fertile spots in the United States. The crops are very diversified and include asparagus (a 10,000,000 dollar crop). The rivers and paved highways serve to bring all the crops to market or to the great canneries at strategic points.

Gyp corn, a dwarf type, grows to nearly double height—seven feet



Asparagus is a splendid crop in Delta lands, worth $10,000,000

Celery is grown on seven thousand acres in the Delta lands and much of it is crated in the field itself

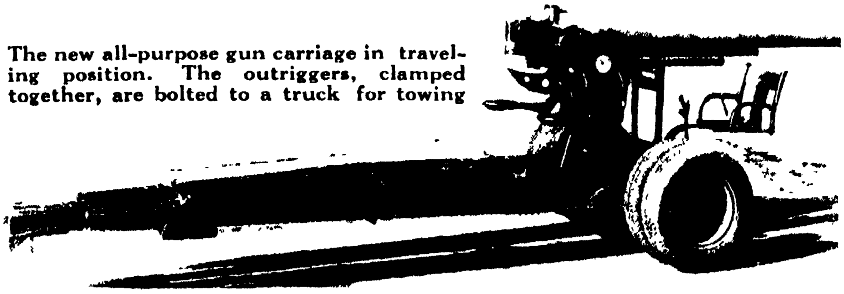
Cutting asparagus in the irrigated fields. Much of our best canned asparagus comes from this locality

Our Army's New Super-Weapon*

By MAJOR G. M. BARNES
Chief, Design Section, Watertown Arsenal, Watertown, Massachusetts

DEVELOPMENTS during and since the war are tending to render the existing field artillery matériel obsolete. It is a well known fact that new field guns and carriages of the division, corps, and army types have been built since the war which are greatly superior to the war types in that the guns give greater ranges. However, the matter is more serious than that, since none of the war types and few of the post-war types of artillery will meet the new demands which will be required of them in future wars.

High-speed targets in various forms are gradually entering the field of fire of all types of field guns, such as the new high-speed trucks used as prime movers for artillery and for carrying infantry, and tanks having cross-country mobility and speeds heretofore unthought of. But even more menacing than the high-speed tanks and trucks are the many types of aircraft, carrying bombs and machine guns, which may swoop down upon the infantry or artillery without warning.



The new all-purpose gun carriage in traveling position. The outriggers, clamped together, are bolted to a truck for towing

It is well known to all field artillery officers and other officers, and civilians as well, who have given thought to the problem, that the present types of field artillery, as exemplified, for example, by the famous French 75-millimeter gun, are wholly incapable of dealing with these high-speed targets. Few of the carriages for these guns permit sufficient elevation for firing at aerial targets, or have sufficient speed in traversing or elevating.

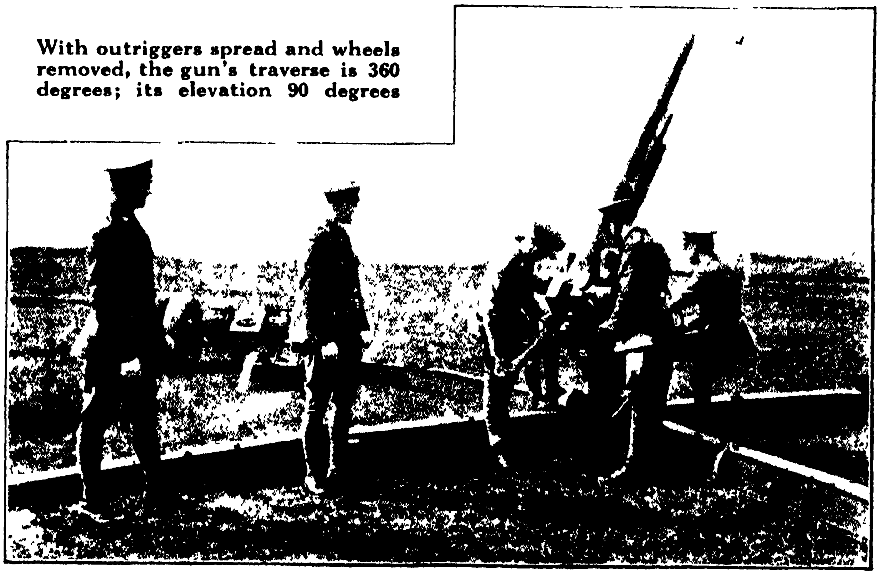
Unfortunately, not only the guns and the carriages but also the fire-control instruments which have been developed for use of field artillery, are wholly unsuitable for use against high-speed moving targets. The fire-control instruments used by a field artillery battery have been developed on the principle of keeping this equipment as light and as simple as possible. Practically all firing data must be computed slowly and laboriously by the personnel of the battery. It will be at once evident that such methods are found lacking when attempting to fire guns continuously at moving targets.

With luck, a battery of divisional guns might destroy a high-speed tank, but there could be no assurance of the same result using the present types of field carriages and fire control. It would be absolutely impossible to bring effective fire upon an airplane traveling at a speed of 100 miles per hour or more, and to attempt it would be purely a waste of ammunition. The present methods of fire control are being adhered to although the increased ranges of the post-war guns necessitate refinements in fire-control instruments and methods.

Furthermore, practically all existing field artillery carriages, up to this time, are defective from the standpoint of modern high-speed transportation in that they cannot be hauled at speeds greater than about 15 miles per hour without seriously damaging the gun carriages and their mechanisms. All the artillery of the World War period was limited in this respect since it had been designed with the idea of using horses or the slow-speed tractors available at that time for tractive forces. Since the war, trucks have been built which are capable of hauling gun carriages at high speed. Commercial development makes it imperative that gun carriages of the future be so constructed that these high speeds can be taken advantage of, not only on good roads, but when the gun carriages are trailed across country.

THESE new conditions, thus briefly outlined, call for field artillery of a new type. The present ideas concerning fire control must be revised and the fire-control equipment of the battery must be augmented so that these batteries can bring effective fire against stationary ground targets, and can also be used effectively both against rapidly moving ground targets and, with equal accuracy and facility, against high-speed targets in the air.

A new type of field-gun carriage which has been developed with the idea of meeting the new requirements referred to above, was completed recently at Watertown Arsenal. This carriage mounts the high velocity 75-millimeter gun (muzzle velocity 2175 foot-seconds) which gives a maximum range of 15,000 yards with a 15-pound



With outriggers spread and wheels removed, the gun's traverse is 360 degrees; its elevation 90 degrees

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*Reprinted through the courtesy of *Army Ordnance*

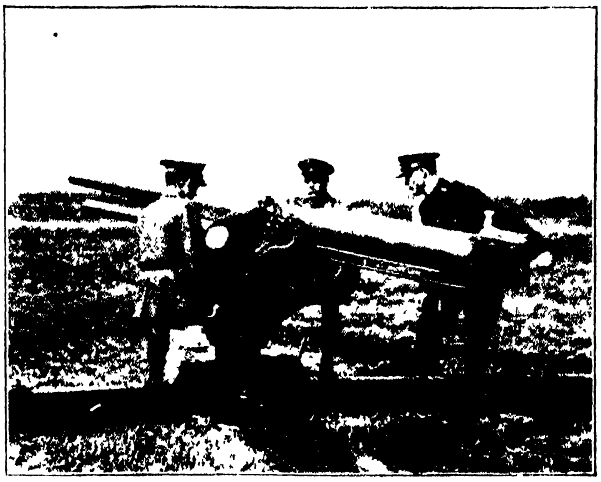
projectile for high or low altitude.

The new carriage has been equipped with wheels mounting balloon tires and having roller bearings at the hubs. The design is such that either single or dual tires can be mounted. The newly developed puncture-proof inner tubes are used. While the dual wheels and tires increase the weight of the gun carriage about 400 pounds, it is believed that tests will show the advantages of having the additional tire contact area. Furthermore, the two additional wheels and tires may be considered as spares, in which case, if one of the tires were punctured, the vehicle would not have to stop. The increased ground contact area will make it possible for the vehicle to pass through sand and soft mud. The construction is such that the gun carriage proper is carried on the wheels and axle as a spring load.

The gun can be fired by opening out the rear trails and supporting the front part of the carriage by means of the two spare trails. Two outriggers with built-in screw jacks are placed on the ground under the carriage pedestal.

WHEN in place, the screw jacks are tightened against the bottom of the carriage; thus the vertical component of the firing load enters the ground through these two outriggers which serve to protect the balloon tires, roller bearings, and the spring suspension from the firing load. The gun can be fired in this manner through an angle of traverse of 90 degrees and at elevations from 0 degrees to plus 80 degrees.

If all-around fire is desired, the carriage can be put in a second firing position. In this case, the two outriggers are used as levers for raising and lowering the carriage. The wheel and axle assembly can be removed quickly from the pedestal of the gun carriage and the latter lowered to the ground. The two spare outriggers are then put into place to complete the base for the carriage. In this position, the gun can be fired through 360 degrees of traverse and at angles of elevation from 0 degrees to plus 80 degrees.



Firing position of the 75-millimeter gun, 360-degree traverse and 15-degree elevation, in full recoil

In arsenal trials, using untrained men, the carriage was put in the first firing position (for 90 degrees traverse) from the traveling position in one minute, and in the second firing position (for 360 degrees traverse) from the traveling position in four minutes.

It is believed that such a gun carriage fully meets the requirements which were outlined at the beginning of this article. The weight of the gun and carriage in the firing position is 5800 pounds, or nearly twice that of the low-velocity 75-millimeter gun carriage of the World War type. However, assuming a four-inch penetration of the tires into the ground, the area of the tires in contact with the ground is 832 square inches as compared with 194.6 square inches for the French 75-millimeter field gun, M 1897, equipped with steel tires, and the ground pressure is 6.9 pounds per square inch as compared with 13.7 pounds per square inch for the French gun. Thus it will be seen that the new carriage will undoubtedly possess greater cross-country mobility than the lighter carriage.

THIS low weight for a high velocity, all-around-fire carriage with dual balloon tires, brakes, and spring suspension, is made possible by taking advantage of steels of high physical qualities, of a new welding process which has been developed at Watertown Arsenal, and by making parts of the carriage, where possible, of strong aluminium alloys having one third the weight of steel. This carriage is equipped with the anti-aircraft type of elevating and traversing mechanisms, employing roller bearings throughout. All blacklash is eliminated, making it possible to lay the gun with an accuracy of ½ mil on either elevation or azimuth.

Fitting of fire control equipment to this new gun mount is still in the experimental stage and somewhat too technical for discussion here.

In center of page the mount is arranged for 90-degree traverse and 60-degree elevation for anti-aircraft firing. At bottom of page, the gun has a 90-degree traverse and an elevation of 15 degrees for firing at speedy land targets. In both cases, the balloon tires, the roller bearings, and the springs are protected against shock of recoil by the special type of construction

Basic Patents in Evolution—III

By WILLIAM K. GREGORY

Professor of Vertebrate Paleontology, Columbia University Curator, Departments of Anatomy and Ichthyology, American Museum of Natural History Member of the National Academy of Sciences

(*Concluded from September*)

TURNING now to the history of the pelvis and hind limbs, we have already noted that in many respects their origin was similar to that of the pectoral limbs, that is, they first appeared as keels or ridges supported by basal rods and operated by extensions of the segmental muscles of the body-wall (Figure 13). Much later they became paddle-like and finally when bent downward (Figure 14) were able to support the weight of the body and to co-operate with the pectoral limbs in pushing the body forward. But the pelvic limbs and the pelvis itself differed widely in their functional associations with surrounding parts and consequently they acquired conspicuous anatomical differences from the pectoral limbs. In the first place, the pelvis corresponds only to the inner or primary shoulder-girdle and it never had any system of sheathing plates attached to it. Secondly, the pelvis was associated with the lower ends of the digestive tract and of the tubes that discharged either eggs or living young in the female or the sperm of the male (Figure 13).

THUS the pelvis arose around the cloaca or common opening of the digestive and reproductive tubes and served as a base or platform of the following sets of muscles: first, those that ran forward along the lower surface of the abdomen; second, those that ran backward along the outer and under sides of the tail (Figure 15); third, for a cone-shaped mass of muscles based on the pelvis and converging outward and downward to form the thigh muscles.

The ilium, or upper branch of the pelvis, at first grew upward between the muscles of the back in front and the tail muscles behind. As it grew upward it passed to the outer sides of the ribs, which were at first entirely free from it. Gradually, however, certain of the ribs became tied by connective tissue and ligament to the inner side of the ilium and when this happened an indirect connection was established between the hind limbs and the backbone. Thus the hind limbs soon acquired great importance both in thrusting the body forward and in steering the front part of it.

In the primitive reptiles with sprawling limbs only a small part of the outer surface of the ilium is occupied by the deep portions of the gluteal mass, which ran outward on to the top of the femur. But when the limbs were drawn in toward the sides of the body in the primitive mammals, the gluteal muscles acquired great importance in holding the body upon the femur when the opposite leg was lifted off the ground. Hence, that part of the outer surface of the ilium which gave rise to these muscles became enlarged in accordance with their increasing importance (Figure 14, D, F, G, H, I).

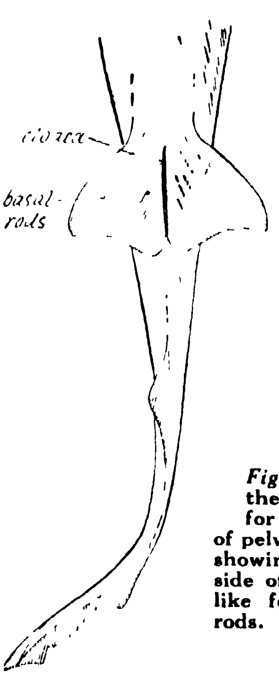


Figure 13: **The basic invention of the pelvis or bony foundation for the hind limbs. Under side of pelvic region of primitive shark, showing the pelvic fins on either side of the cloaca; they are keel-like folds supported by skeletal rods. Drawing from specimen**

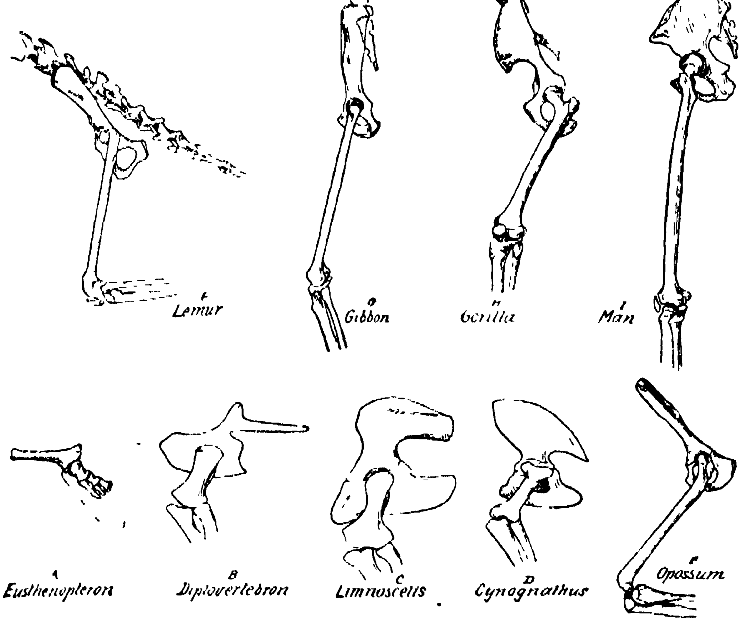
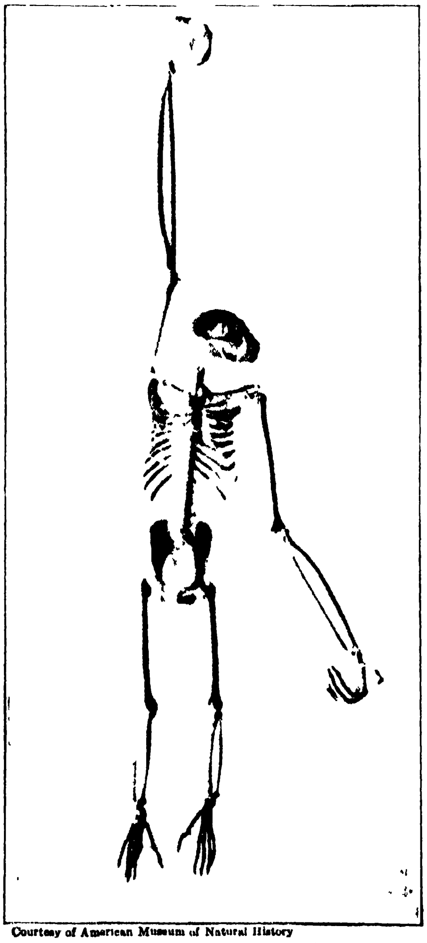


Figure 14: **Series showing progressive outward growth of ilium from fish to man. (A) Lobe-finned ganoid (*Eusthenopteron*) of the Devonian period; (B) *Diplovertebron*, early tetrapod; (C) primitive reptile (*Captorhinus*); (D) advanced mammal-like reptile (*Cynognathus*); (E) primitive mammal (opposum); (F) primitive primate (lemur); (G) gibbon; (H) gorilla; (I) man. This series of drawings was made chiefly from models and specimens in the American Museum of Natural History at New York**

In the early mammals when the knees were drawn forward the ilium also grew forward almost parallel with the backbone (Figure 14, E), to which it was now attached by means of the sacral vertebrae and their ligaments. At first in the mammals the upper part of the ilium was trihedral, that is, triangular in cross-section, its three surfaces being occupied respectively by the muscles of the upper side of the backbone, by the iliacus muscles in front and by the gluteal muscles on the outer side. When the primates began to sit upright (Figure 14, G), resting themselves on their folded-up legs and on the lower ends of the pelvis, the iliac muscles served to check them from falling backward, while the gluteal muscles prevented them from falling forward. Hence with the increased size of these two sets of muscles the blade of the ilium began to grow outward in a transverse plane, the chief successive steps in this broadening process being recorded in the lemurs, monkeys, apes and man (Figure 14, F, G, H, I).

In the first section of this article we saw that in a primitive quadruped the body is slung between two suspension towers, which are the pectoral and pelvic girdles. The gibbon of the East Indies (Figure 16) has succeeded in turning this suspension bridge up at right angles to its original horizontal position and in balancing it on its rear tower, represented by the pelvic girdle. In other words, in the gibbon Nature has already worked out the basic invention for upright or bipedal progression on the ground. This great step in advance is seen first in its viscera, which approach the human type in a number of ways, and, secondly, in the details of construction of its pelvis.

But how did the gibbon learn thus to run on its hind legs? The answer of comparative anatomists is that the first step was the habit of sitting upright and the second was the habit of brachiating, or climbing with the arms raised above the head and the body suspended beneath the branches. The habit of sitting upright, as we have seen, conditioned the first steps in the remodelling of the pelvis, especially the flattening of the ilium in the transverse plane. The habit of brachiating conditioned the extension to and upon the upper border of the ilium of certain muscles of the loins and abdomen, which thus found themselves in a better position to support the viscera, pelvis, and hind limbs when the body was suspended from the arms. But the gibbon is no longer content merely to climb deliberately with his forearms; he makes enormous leaps from one branch to another one in the distance, and in taking off for the leap he can extend his thighs backward so that they may be nearly parallel with the backbone; whereas in a quadruped, with its backbone in the horizontal position, the thigh is but rarely extended so far backward. The result of this habit of the gibbon is that when it comes down on the ground to walk it has no difficulty in extending the thighs downward parallel to the backbone.



Courtesy of American Museum of Natural History

Figure 16: **The ape that solved the problem of walking upright. Skeleton of gibbon from the East Indies**

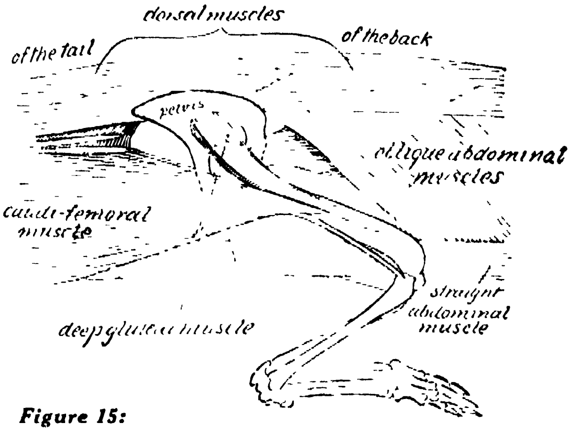


Figure 15:
Pelvic musculature of a crocodile. After Romer, 1923

But is there any reason to suppose that our own remote ancestors, which from all the evidence of comparative anatomy were admittedly related to the anthropoid stock, learned to walk upright on the ground only after a long course of instruction in brachiating in the trees? The answer is, yes, since the human skeletal and muscular systems, as well as the brain and viscera, still retain abundant traces of a brachiating, arboreal stage that immediately preceded the stage of upright walking on the ground.

In the first place, the entire shoulder-girdle, arm, and hand of man are far more nearly approached by those of the brachiating anthropoid apes than by those of any other known animals living or extinct, and the same is true when we compare the pelvis and hind limbs of the two groups. It is truly surprising that, although the pectoral limb of the anthropoids is chiefly an organ of locomotion, while that of man is used almost exclusively for carrying or manipulating objects, in spite of this great functional difference the anatomical resemblances between the forearm of man and those of the gorilla and the chimpanzee are such as to amount almost to identity, while the differences are limited chiefly to differences in the lengths of the corresponding segments of the hand and arm. Thus the hand of the chimpanzee, for example, is much longer than that of man, at least in proportion to the body size, while its thumb is notably degenerate in size; yet the humerus, radius, and ulna closely resemble those of man and the same is true of the bones and muscles of the hand. These fundamental resemblances between man and anthropoid are well brought out in Figures 17 and 18.

Objection to the derivation of man from brachiating ancestors has been made on the ground that the habit of brachiating in the anthropoids has led to the use of the hands merely as hooks and to the consequent degeneration of the thumb; also that the mobile hand of man with its well developed thumb could never have been derived from a brachiating type. The answer to this line of argument may be sketched* as follows: first, that it is not necessary to attribute to the common ancestors of man and the anthropoids the extreme specializations of either of their descendants and indeed all the available evidence indicates that while the thumb of the chimpanzee has been reduced, that of man is a progressive structure which has experienced an increase in adjustment with its increased functional importance. Secondly, the evidences of both hand (Figure 17) and foot (Figure 18) indicate that the remote ancestors of man were primates of arboreal habits, with hands and feet more like those of the gorilla and the chimpanzee than like those of ordinary monkeys; also, these are the only known kinds of hands and feet that would work well with the particular forms of shoulder-girdle, arm, pelvis, and hind limb, which upon quite other grounds there is good reason to attribute to the common ancestors of the anthropoids and man.

In short, from the point of view of comparative anatomy, these and many other resemblances between man and the anthropoids are due neither to chance nor to "convergent evolution," because they are too numerous and too detailed. They can mean only that both man and anthropoid have descended from a common ancestral stock which was already brachiating, yet was perhaps somewhat less specialized in this way of climbing than is the chimpanzee.

In conclusion, the chief "basic patents" in the locomotor apparatus in the long ascent from fish to man appear to have been as follows:

(1) The appearance of the striped muscle fiber, under the control of the nervous system. This is the stage attained by many invertebrates.

(2) The building up of these muscle fibers into zigzag muscle segments separated by tough partitions of connective tissue. This is the stage attained by *Amphioxus*.

(3) The assumption of a streamline body-form, propelled by lateral undulations caused by the rhythmic

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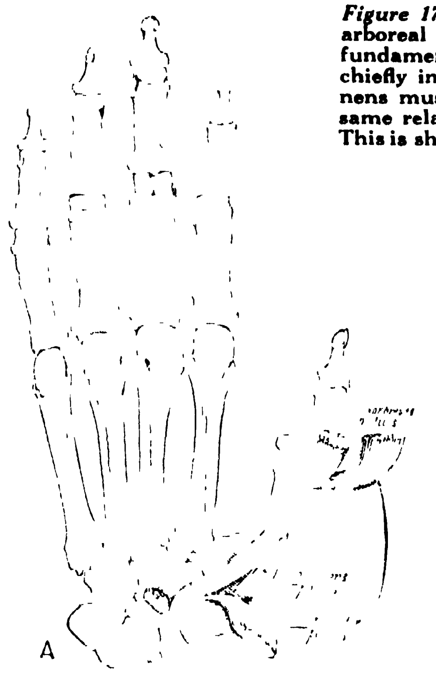
* For a fuller presentation of the evidence, see the author's papers in the Proceeding of the American Philosophical Society, 1926, Vol. LXVI, pp 439-463, 1928, Vol. LXVII, No. 2. pp. 129-150; No. 4. pp. 339-376.



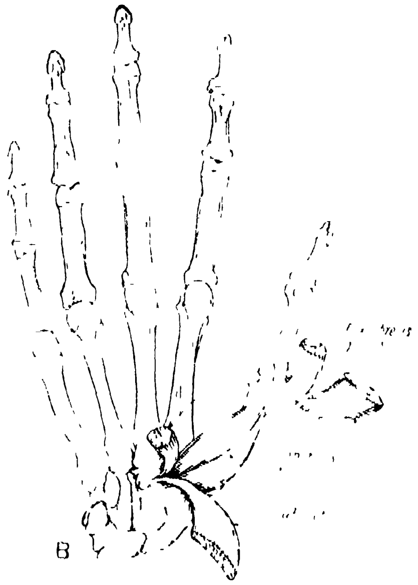


Figure 17: **The testimony of man's hand as to his arboreal origin. Man's thumb, it will be seen, is fundamentally similar to that of the gorilla, differing chiefly in its relatively greater length. The opponens muscle is present in the gorilla and has the same relations to surrounding muscles as in man. This is shown in the drawings. (From Gregory, 1928)**

contraction of the muscle segments. This is the stage attained by *Amphioxus* and the oldest ostracoderms.

(4) The development of an axial skeletal system laid down at the points of greatest stress at the intersection of the primary and secondary septa, between the muscle masses. This is the stage attained by the shark.

(5) The development of an appendicular skeletal system, beginning in the form of keel-like projections of the body-wall, supported by segmental cartilaginous rods, as in the oldest sharks; from these rods evolve gradually the skeleton of the paired fins, the shoulder-girdle, and the pelvis, successive stages being seen in the different sharks.

(6) The operation of the paired fins by muscles that were originally derived from the segmental muscles of the body-wall but which soon became organized into a definite system consisting of a dorso-medial group above and behind the pectoral paddle, and a ventro-lateral group below and in front of the paddle. A similar system develops simultaneously in the pelvic fins. Different stages in this development may be observed in the sharks, lobe-finned fishes and early amphibians.

(7) The development of freely movable paired paddles with a fan-shaped skeleton from the keel-like ridges already mentioned. Stages of this development are observable in sharks and lobe-finned fishes.

(8) The remodeling of the paired fins and shoulder-girdle of some early lobe-finned fishes after they had "learned" to turn the fins downward and to use them to assist in wriggling along on land.

(9) The development of the "double suspension bridge," by which the weight of the body was supported between one U-shaped and one V-shaped sling made from the pectoral and pelvic girdles respectively. This is the stage of the oldest known tetrapods.

(10) The development of a connection between the V-shaped pelvis and the backbone. This stage was attained by later tetrapods.

(11) The raising of the body off the ground and the drawing inward of the feet, elbows and knees. This stage was initiated in the mammal-like reptiles, perfected in the mammals.

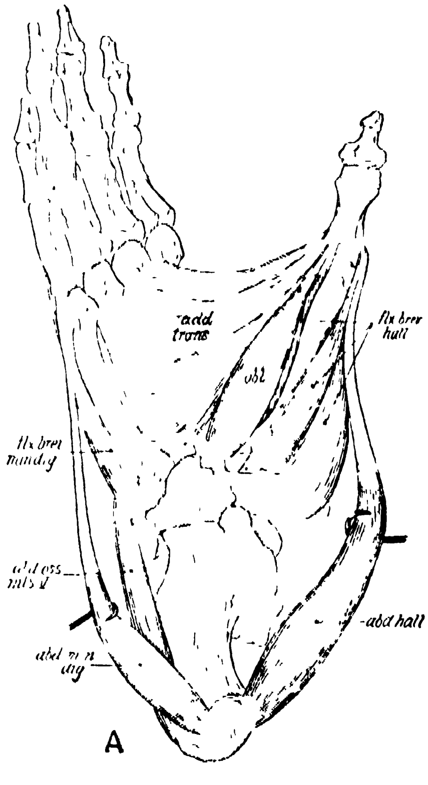
(12) The invasion of the trees and the establishment of the habit of sitting upright. This stage is observable in the lemurs and monkeys.

(13) The development of the habit of brachiating, or climbing with the arms extended above the head and the body suspended from the arms, by which were acquired very many prerequisites for erect, bipedal progression on the ground. This stage is seen in the gibbon.

(14) A marked increase in size of body, which became too heavy for comfortable climbing in the trees, and the gradual abandonment of tree-living in favor of upright, bipedal progression on the ground. This stage is today observable in the gorilla and was with high probability passed through by our own ancestors. The gorilla, however, is now becoming secondarily quadrupedal.

(15) A profound readjustment of the viscera and of many parts of the skeleton to secure more favorable arrangements for supporting the body in the upright position. The early stages in this transformation have already been passed by the gibbon, chimpanzee, and gorilla. The later stages are now observable in man.

Although many details as to the "basic patents" that led up to man's present locomotor apparatus remain to be worked out, it is unlikely that we can be very far off in the foregoing sketch of the main stages, because much consistent evidence of the evolution of the jaws, teeth, skull, brain, and so forth is already on record.



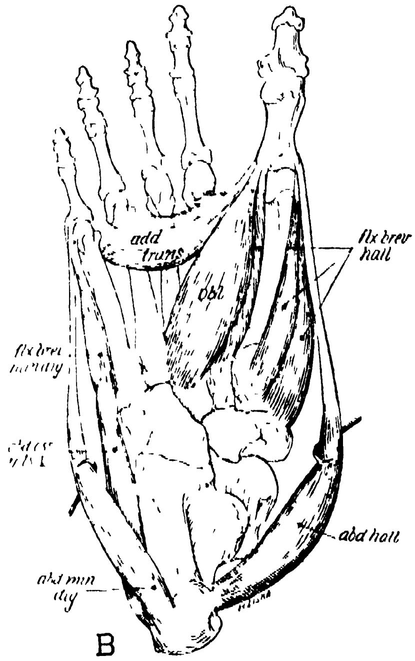
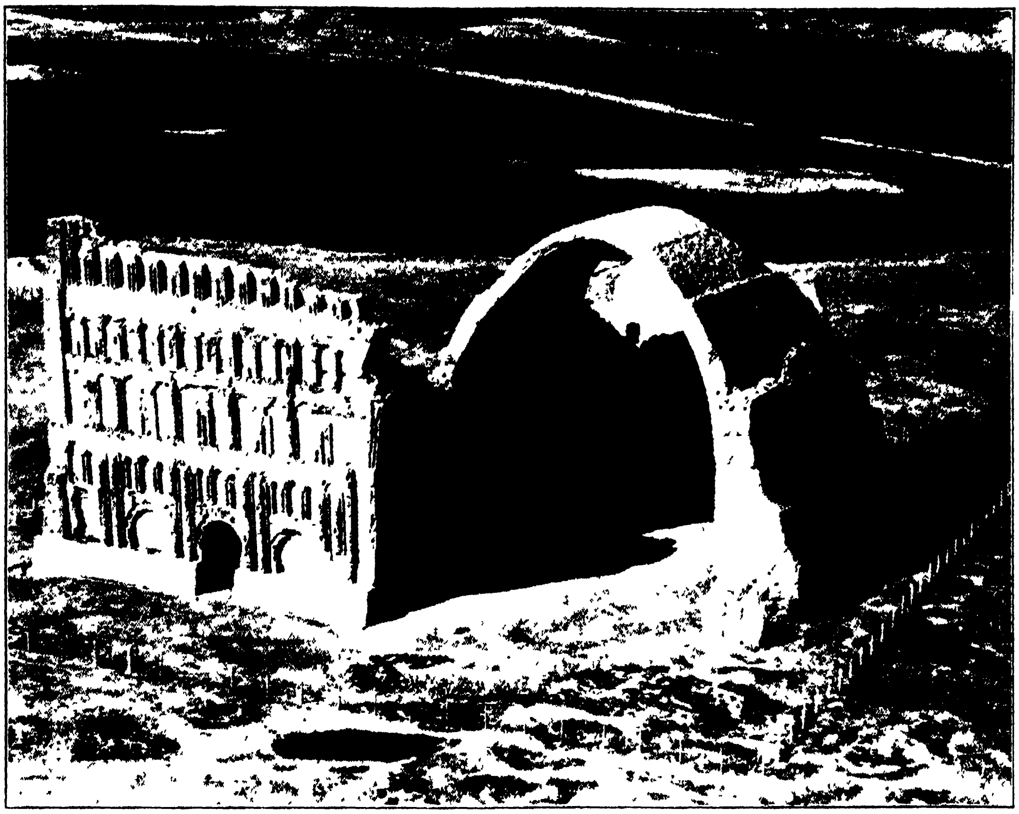


Figure 18: **The testimony of man's foot as to his arboreal origin. Externally the sole of a human foot superficially resembles that of a bear, but internally its construction is an evident modification of the "biramous" type, with a grasping great toe. In spite of the almost exclusive use of the human foot for walking on the ground, the great toe is operated by muscles that evidently correspond closely with those of the gorilla foot, as is shown. (From Gregory, 1928)**

Ctesiphon was an ancient city of Mesopotamia, about 25 miles southeast of Bagdad. The principal remains are a magnificent arch of the Sassanian period. The Neo-Persian Empire was founded in A.D. 226 and was destroyed by Arabs in 637. A tremendous battle was fought here on November 21, 1915



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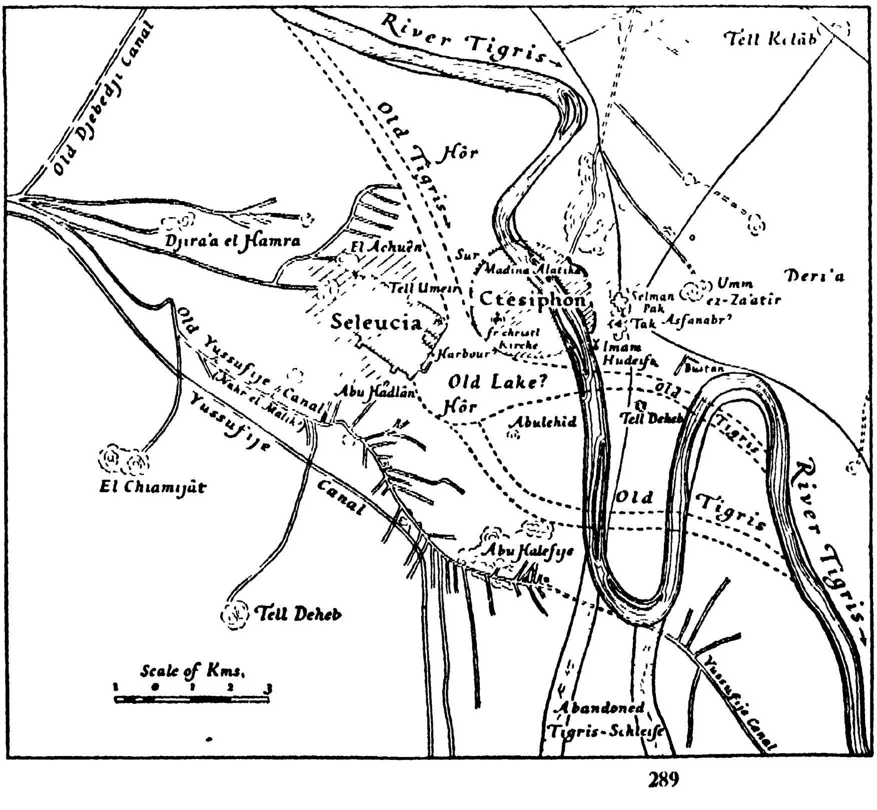
Ctesiphon, A Magnificent Fragment

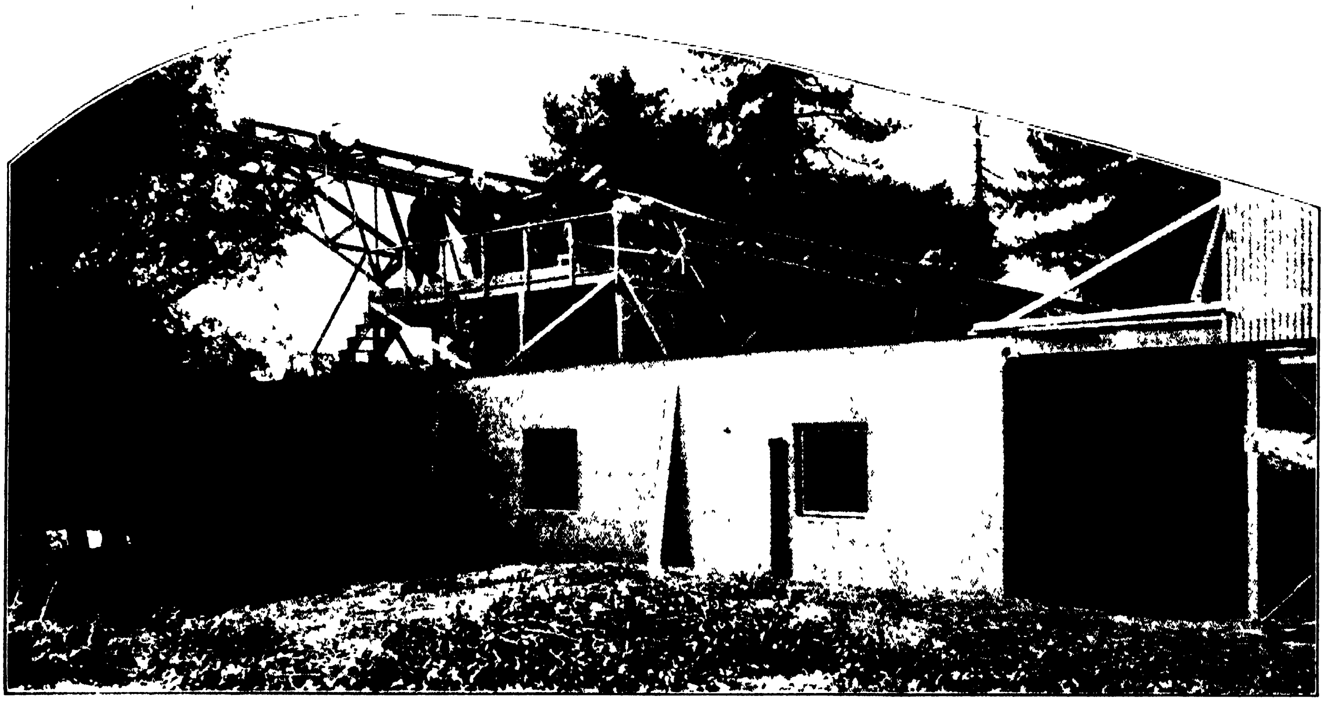
IN the autumn of 1928 a German archeological expedition began to excavate the site of Ctesiphon, the capital of the Sassanid Empire. Here was a great battleground where the conflict raged on the Euphrates and Tigris between East and West, between the Orient and Hellenism. For a thousand years Seleucia was an outpost of conquering Greece in the East while Ctesiphon was the center of Sassanian royal power. Both were symbolic of the two conflicting worlds. Our esteemed contemporary *Antiquity* publishes an interesting account of the painstaking excavations and the results thus far obtained. Our readers probably will be most interested in the gigantic barrel-vaulted hall of the royal palace of Ctesiphon. The date is probably somewhere between 531 and 579 A.D.

The main front of the edifice is 312 feet long, the height is 115 feet and the depth is 175 feet. The great hall has an elliptical barrel vault 86 feet wide and 163 feet long and is open in front. The springing of the vault is 40 feet from the ground. The brick courses are horizontal and project inwards as they rise, so that the actual width of the vault portion is only about 71 feet. The crown of the vault is nine feet thick. It was probably built with centering. Being located on an alluvial plain no stone was available so brick was employed.

The best view of the noble ruin is from the air and now that the authorities of Iraq permit archeological investigations and air flights we may look for further discoveries made by means of aerial photographs.



Map of the district around the rival cities Ctesiphon and Seleucia. The former was the center of Sassanian power, the latter an outpost of conquering Greece in the East. In time, both cities fell



The new 50-foot interferometer tipped about one hour east. The outer diagonal flat mirrors stand about 35 feet apart. The lower half of the housing is of concrete, the upper half is a metal shed (see page 293)

The New Fifty-foot Stellar Interferometer

By F. G. PEASE
Mount Wilson Observatory

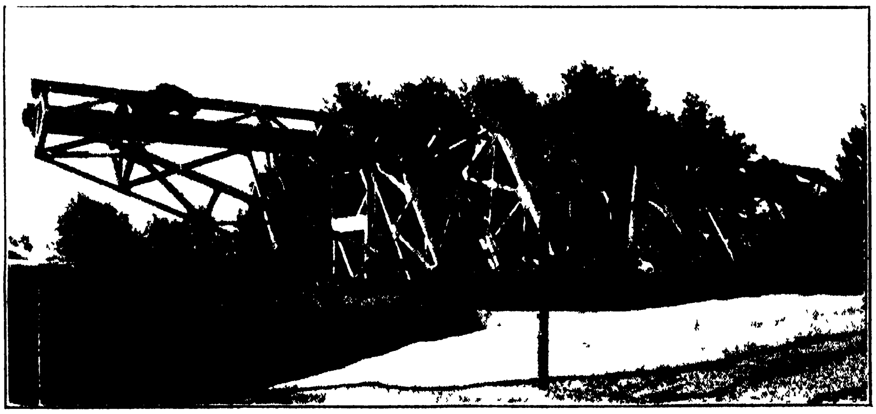
THE star image formed at the focus of a telescope is not a point but consists of a bright central disk surrounded by several dark and bright rings known as the diffraction disk. No known star except the sun has an angular diameter large enough to appear as a real image in existing telescopes, that is, its actual disk can not be seen, consequently one can not measure its diameter with an ordinary micrometer.

Fizeau pointed out that it might be possible to measure the true angular diameter of stars with a stellar interferometer. This instrument utilizes the principle of interference long familiar to physicists wherein two pencils of light radiating from the same small source are brought together again, forming a series of bright and dark bands called "interference fringes."

In the stellar interferometer the star image has the same appearance as it does in an ordinary telescope except that it is crossed by a series of parallel dark bands, that is, the interference fringes. Each point in a star produces one of these interference patterns. If the star is very small in angular size the fringe patterns all lie directly on top of one another and are clear and sharp. If a star of larger angular diameter is chosen each point in it produces a pattern which is displaced a little with respect to the original one, thereby reducing the clearness or visibility of the fringes. A still larger star may be selected in which there may be so many overlapping patterns that all the dark bands disappear and just the ordinary image remains. Two radio sets receiving from the same studio will blend well, but two sets receiving from adjoining studios emitting different modulations, even though the wavelength be the same for both, will not blend but will have only sound as a result.

IN the stellar interferometer we take advantage of the disappearance of the fringes to measure the star's diameter. Mathematicians have computed that when this occurs $a = 1.22\frac{\lambda}{D}$ where a is the angular diameter of the star in radians and λ the wavelength of the light and D the separation of the centers of the two pencils of light.

Since no existing telescope was large enough to give complete disappearance of the fringes Michelson devised a periscopic attachment consisting of four plane mirrors mounted on a stiff frame which is placed on the end of the telescope. Two outer mirrors inclined at 45° face upward, and throw the light to two inner mirrors which are inclined at 45° facing downward, directing the light into the telescope. The outer mirrors move simultaneously on slides to equal distances from the axis of the telescope.



The bridge of the new nine-ton instrument from the north side

The distance to the star from the focus of the telescope over the two paths must be the same to within a very few wavelengths of light, otherwise the fringes will not appear at all. Owing to flexure of the telescope, atmospheric variations, and slight errors in setting the mirrors it is convenient to use an optical compensator just in front of the eyepiece, with which the distance may be equalized.

As an illustration of the practical application of the interferometer method let us turn the 100-inch telescope with its full aperture on Rigel and no interferometer attached to it. We see in the eyepiece a bright image without surrounding rings, since the atmosphere rarely permits their presence in the 100-inch. Placing a canvas over the end of the tube and cutting a hole in it seven inches in diameter whose center lies 47 inches from the axis we see an image very much fainter but larger in size showing diffraction rings.

CUTTING a similar hole in the canvas diametrically opposite, that is, with centers of the openings 94 inches apart, we see an image twice as bright crossed with parallel dark bands. With good atmospheric conditions the image appears single but if the seeing is poor the two images vibrate about a common center. Let us now turn to Betelgeuse. To our surprise we see the bright diffraction image but the fringes are not sharp and distinct. Covering these last two openings and cutting in their stead two others 45 inches apart the fringes become almost as prominent as on Rigel.

READERS who keep up with science doubtless will recall the striking confirmation, made in 1920 by means of the Michelson-Pease interferometer, then new, of the prediction that many of the stars were immense beyond conception. The giant star Antares, for example, was found to be 400,000,000 miles in diameter and Betelgeuse 250,000,000 miles. The brilliant work was what might fairly be called a legitimate scientific sensation.

What the interferometer really did was to measure the diameter of a star, not in miles, but in fractional degrees of arc. The diameter in miles was then derivable from this by trigonometry, since the distance to the chosen stars ("parallax") already were known How the interferometer actually measures the angular diameter of a star can not be explained here. The interested reader is requested to see Russell, Dugan and Stewart's "Astronomy," pages 740-748, which covers it adequately and understandably in theory and practice.

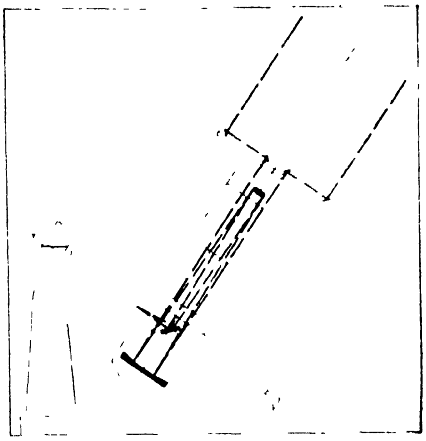
To measure more stars a larger instrument has been needed. Now, ten years later, it has been built and Dr. Pease, who had much to do with its design and construction, was invited to describe it for our readers.

—The Editor.

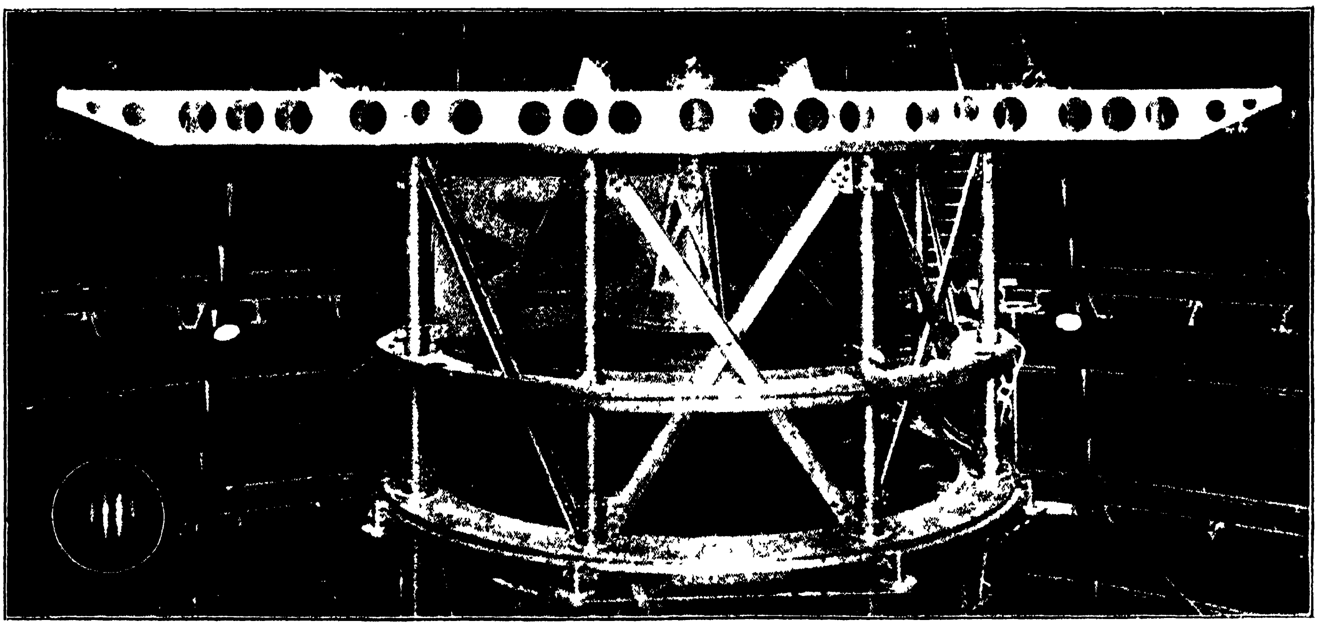
We next place the large steel beam carrying the four diagonal plane mirrors on the end of the 100-inch tube, using the crane, since it weighs about 800 pounds. The canvas will be left over the end of the tube, as the light from the inner mirrors will pass through the openings 45 inches apart. We next set the outer mirrors 110 inches apart and turning to Betelgeuse again, we adjust the compensator until the fringes appear. We have to look very carefully for them because when they do appear they are very weak, the dark spaces having almost disappeared. Shifting the outer mirrors to 120 inches we are unable to see any fringes regardless of how long we search for them. Turning the telescope to Rigel the fringes are found almost immediately and appear as crisp as they did when the apertures were closer together.

Taking the separation of the mirrors D as 120 inches, or 305 cm, and λ as 5.75×10^{-5} cm, we find that a equals 2.3×10^{-7} radian or 0.″047 arc, the angular diameter of the star. The angular diameter of Betelgeuse appears to vary irregularly; there are days when the mirrors must be moved 11 feet apart in order to cause disappearance of the fringes.

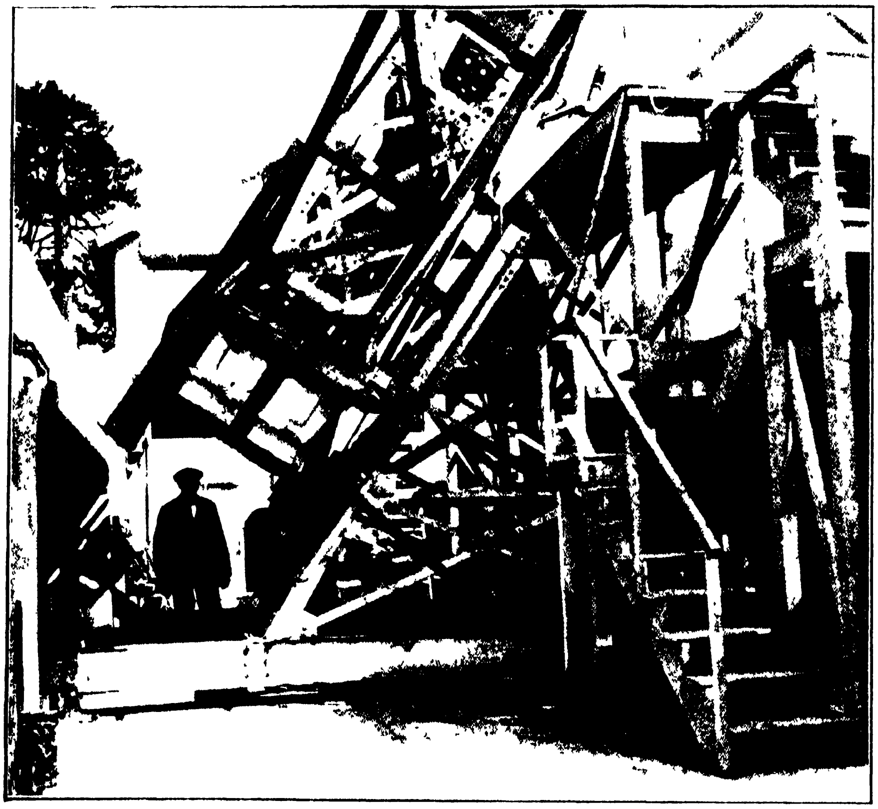
The minimum angular diameter measurable with the 20-foot interferom-



How the earlier, 20-foot interferometer was employed attached to the 100-inch telescope. Two pairs of diagonal flat mirrors gave it, in effect, a spread or aperture of 20 feet, instead of the 100 inches of the telescope. The diagram shows the light path of two rays



The old 20-foot interferometer beam bolted to the end of the tube of the 100 inch reflector. The two inner mirrors remained fixed but the outer pair could be moved inward or outward. The circular holes in the bar were merely to save weight. *Insert, lower left:* Typical appearance of the interference fringes, a series of bright and dark bands



Pedestal and lower part of the "bridge." The 40-inch main mirror in its cell is above the man's head (Ladd, machinist). Opposite his shoulder is the worm and sector drive. One of the rollers is visible higher up. The slanting polar axis shows beneath the peak of the main supporting A-frame

eter is 0.″024. The diameters of Arcturus and *β Pegasi*, which are slightly smaller than this, were found by plotting the visibility curve for various mirror separations and determining D from the extrapolated curves for zero visibility.

The diameters of stars measured with the 20-foot instrument were of the same order as those found by indirect methods. All of the stars measured were "late" type stars.

IN order to measure stars of "earlier" types which have smaller angular diameters it is necessary to have a larger interferometer. Accordingly the new 50-foot interferometer has just been built at the Mount Wilson Observatory, in which the apertures are larger and can be placed 50 feet apart. This instrument will measure a star diameter as small as 1/100 second of arc, about corresponding to that of a cent piece at a distance of 250 miles.

The 20-foot instrument was of such a size that the steel frame carrying the periscopic mirrors was placed on the upper end of the 100-inch Hooker reflecting telescope, the optical system of the telescope itself being utilized in forming the star images. But a 50-foot beam would be too large to place upon the 100-inch. So the new instrument is a unit in itself and is housed in a separate building, whose upper half is a metal shed which moves to the east on a trestle, leaving the interferometer standing in the open air. The building is 60 feet long, 20 feet wide and 26 feet high. The shed is moved by rack and pinion.

The interferometer consists of a large skeleton frame which we call the "bridge," mounted in cantilever fashion on the north end of a short ball-bearing polar axis. A structural steel pedestal supports the whole and carries the mounting for the worm that meshes into a sector on the bottom of the bridge. The bridge lies in an inclined plane parallel to the equator and carries the periscopic mirrors on its upper surface and the image-forming mirror at its lower end.

The bridge is a latticed steel frame 54 feet 5½ inches long. The structural members are all angle iron and vary in size from 6 x 6 x 3/8 inches to 3 x 3 x 1/4 inches. The estimated weight of the bridge itself is 8000 pounds and the total load on the axis including the mirror mountings, tracks, and so on, is about 18,000 pounds.

The polar axis is of 0.50 carbon steel with an elastic limit of 80,000 pounds per square inch. It is forged and heat treated and drawn so hard that it was machined with difficulty. Each of its bearings is composed of two S K F annular bearings. To guide the bridge and prevent its vibrating in the wind two rollers nine inches in diameter with spring cylinders behind them are fastened to the bridge and travel on a circular track fastened to the north face of the pedestal.

The driving sector is a large iron casting bolted to the bottom and south sides of the bridge. It is 100.2671 inches pitch radius and has 1440 teeth. The worm is 4½ inches pitch diameter, 0.4375 circular pitch, left hand, single thread. It runs on S K F self-aligning bearings and continually dips into a bath of clock oil which is free from acids and gumming properties.

The driving clock is of the typical weight-driven conical governor type and is self winding. It stands just east of the pedestal and transmits power to the worm through a gear box. Slow motion in right ascension is by means of a motor mounted directly on the planetary gearing in the gear box. The instrument works in right ascension from 2 hours east to 2 hours west.

ONE of the illustrations shows an outline of the optical path of the interferometer. Two outer plane mirrors AA inclined at an angle of 45° receive the parallel beams of star light and reflect them to two similar mirrors BB inclined also at 45° which direct them downward to the large concave mirror C. The converging beams are then returned upward to a 45° plane mirror D, thence southward to a second plane mirror E and upward through the compensator to the eyepiece.

The flats AA, BB, and D are of Pyrex, 15 inches in diameter, D being cut away at the sides to clear BB. E is a glass mirror five inches in diameter mounted with a self-aligning mechanism which directs the beams constantly into the eyepiece tube which may be moved into various convenient positions for observing.

The concave mirror C is of Saint Gobain glass, 40 inches in diameter, 18 feet focus and lies at the bottom

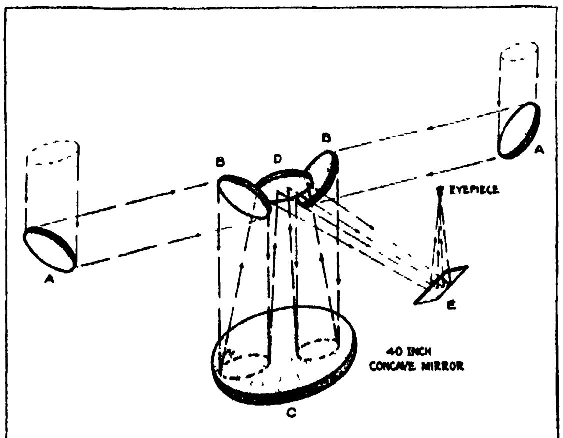
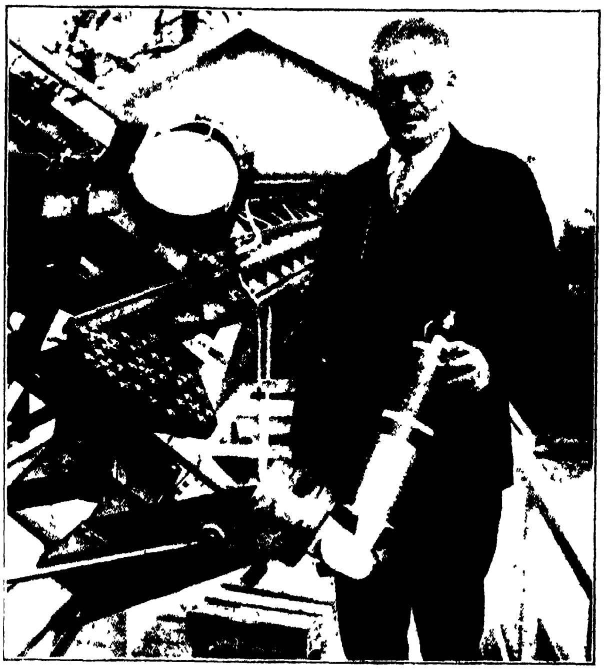


DIAGRAM OF LIGHT PATH IN 50 FOOT INTERFEROMETER
MOUNT WILSON OBSERVATORY
PASADENA CALIFORNIA

of the bridge in an iron cell insulated with corkboard. It is supported on its back by three fixed plates and one central counter-weighted plate and on its edge by four pivoted arcs.

The outer mirrors are mounted on V-wheeled carriages which are moved by motor through a herringbone rack and pinion along tracks placed on the top surface of the bridge. For the tracks heavy machined iron castings of inverted "T" section are bolted to the top of the bridge. To these are fastened steel bars bevelled on both their narrow edges. The upper edges receive the fixed V rollers of the carriages while the lower edges receive similar V wheels mounted on spring counter-weighted arms which always keep the carriages in contact with the tracks.

The carriages may be moved from 6 to 50 feet apart and their positions are read by pointers on scales graduated directly on the tracks. Positions are read through a system of mirrors by a telescope located near the eyepiece tube.



The "business" part of the bridge. The author's hand is on the eyepiece, and at his right are the control buttons. The east diagonal 15-inch flat mirror with its track and rack is visible. When the photograph was made the special mirrors and "telescope" for reading the scales and circles, described in the accompanying text, were not attached

THE outer mirrors rotate for declination about centers passing through a common axis parallel to the top of the bridge. Both fast and slow motions are provided. Readings by circle and vernier are made through a system of mirrors with the same telescope used for reading the mirror separation.

The three central plane mirrors are mounted on a cast iron frame which stands on the top surface of the bridge directly above the large mirror. The central mirror is fixed; the other two can be tilted for slow motion about axes parallel to the polar axis. The east mirror is mounted on a slide capable of micrometric motion along the beam and furnishes an additional means of compensating the optical path length for variations due to flexure, differential expansion, and atmosphere.

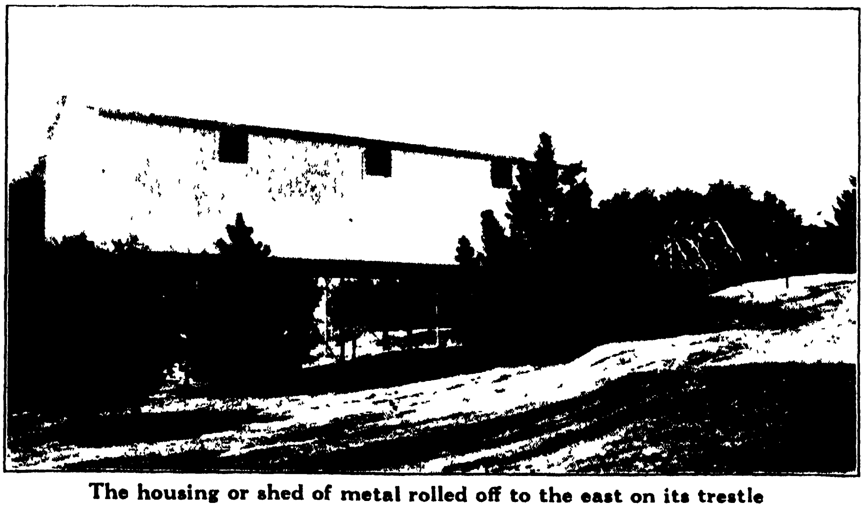
Observations are made from a platform located south of the bridge above the polar axis. Here are placed the eyepiece, the control buttons, circle and scale lamp switches, and the telescopes for reading the circles and scales. All motions in the instrument are motor driven and are operated through relays. An eyepiece of one-eighth-inch focus is necessary to view the fringes conveniently.

The alignment of the instrument during construction was made by squaring the pedestal with the house and checking the polar axis for azimuth on the 60-inch reflector axis with level and gage. When the instrument was about finished the alignment was checked on Polaris by means of a rod carrying cross wires clamped to the bridge. Final adjustment was made by taking drift curves of equatorial stars directly reflected from an uncovered portion of the large concave mirror, computing the error and adjusting the screws at the base of the pedestal.

Drift curves were next taken of the images from the flat mirrors which were found to shift in opposite directions along the declination cross wires. Eight and ten foot straightedges were clamped in various positions about the beam and the shifts measured after moving the instrument into various positions. The addition of several ties has practically eliminated this drift.

The first experiment made with the interferometer was to see whether fringes would show at distances greater than 20 feet. Experimental curves obtained with the 20-foot instrument showing decrease in visibility for a drop in the seeing had been plotted for stars of small angular diameter. Extrapolation of these curves indicated that for "seeing" even as low as 1 on a scale of 10, fringes should appear for distances much greater than 20 feet. At the time the 50-foot interferometer was tried out the seeing varied from 1 to 2 and it was noted with feelings of great pleasure that at the distances of 25 feet and 34 feet at which it was tried the readings coincided with points on the curves. Visibility curves of Betelgeuse and Arcturus made during seeing 1 to 2 also coincided with those made with the 20-foot beam, indicating that measures of star diameters made with the two instruments are alike.

IT is estimated that stars as faint as fourth magnitude can be measured and that complete disappearance of the fringes will take place for about 25 stars. Others whose diameters are still smaller can be estimated by plotting the visibility curve. The appearance and amplitude of vibration of the image given by the two mirrors appeared to be the same regardless of their separation, thereby giving evidence of atmospheric conditions favorable to telescopes of large apertures.



The housing or shed of metal rolled off to the east on its trestle

Nothing but toys are made here. Interior view of a large plant which manufactures toy aircraft. Large supplies of raw materials are in the foreground, and the lines of presses for stamping out parts are visible at the left

The Juvenile Aircraft Industry

By G. ANDERSON ORB

A SMALL boy, eight or ten years of age, was convalescing in a New York hospital. A friend brought him a demountable toy airplane to pass the time away. Looking it over carefully, the boy gave a grunt of disapproval as he said, "Huh! The chap who made that doesn't know much about airplanes propeller's set at the wrong angle!" And that evening a scribbled note went out to the manufacturer calling his attention to the incorrect part.

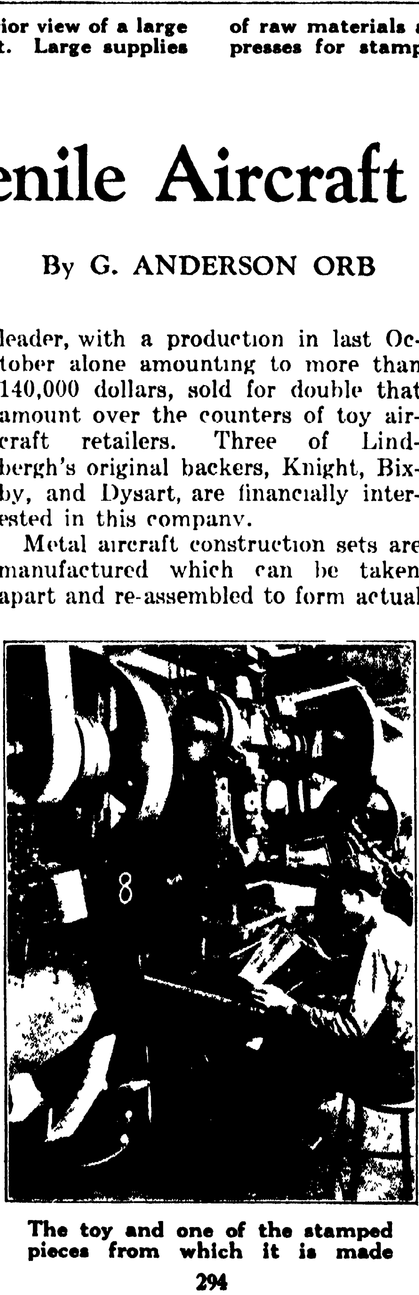
Now, the significant thing about the above incident is the fact that that boy is just the average boy of today! He is just one of thousands! And these same boys are setting the pace for the aircraft of tomorrow.

THERE is no one to whom the romance of aviation makes more of an appeal than it does to the boy between seven and 15 years of age, and these boys are building model aircraft by the millions of every kind.

Perhaps no better measure of the significance of an industry is to be had than in the size, type, and value of the plants that cater to its needs.

While there are perhaps 2000 manufacturers in the field who are catering to the juvenile aircraft demand, there is one firm, the Metalcraft Corporation of St. Louis, which is far and away the leader, with a production in last October alone amounting to more than 140,000 dollars, sold for double that amount over the counters of toy aircraft retailers. Three of Lindbergh's original backers, Knight, Bixby, and Dysart, are financially interested in this company.

Metal aircraft construction sets are manufactured which can be taken apart and re-assembled to form actual replicas of well known ships, such as the *Spirit of St. Louis;* the *Bremen,* the *America,* a tri-motored Fokker; a Waco one-motor bi-plane; a monoplane; in fact, some 500 planes can be built from one set. There are also blimp sets and a model *Graf Zeppelin,* with a complete line of airplane equipment, including airports, hangars, beacon lights, mooring masts, and landing field.



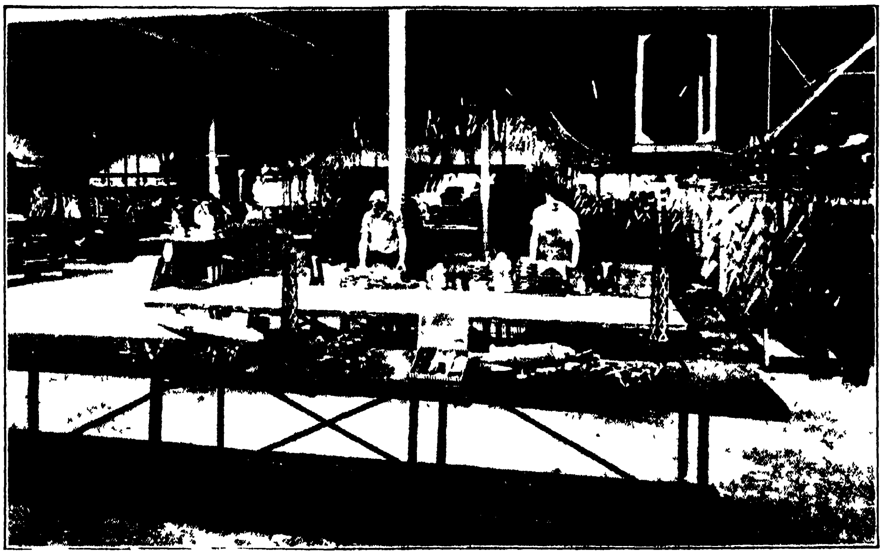
The toy and one of the stamped pieces from which it is made

The factory is completely electrified and the processes of manufacture rival full size production. Dies have been perfected for use in punch presses which stamp out every kind of part required in the construction of any type. When rigidity is desired, spot and butt welders come into use. A plating room has complete equipment for chromium-plating all metal pieces except those to bear a color.

A MOTOR-DRIVEN continuous conveyor, holding racks upon which various parts in process of manufacture are hung, carries them through the enamel vats and on into a long oven where the color is baked on, and thence out to the packing tables. This conveyor has a capacity of 40,000 pieces per hour when running under high-speed production. Belt conveyors of a different kind expedite both assembling and packing of the various construction sets.

A national organization, the Lyonsport Aero Club, composed of boys owning sets manufactured in this particular plant, is equipped with aviation uniforms and winged pins which admit them free of charge to view certain war films, and also entitle them to a ground course in one of the St. Louis air colleges with a proficiency certificate of the same nature as that for adults.

THIS Lyonsport Aero Club, commanded by Captain Jack Bursey, has juvenile pilots all over the world. National advertising over one of the big radio chains carries the stories of adventure to this juvenile audience of aviation enthusiasts, and spurs them on to greater work and a broader aircraft education.



A section of the electrically-operated carrier system on which metal parts are carried through enameling vats and bake oven, thence to the loading table

It was about 1911 that the Illinois Model Air Club was organized among Chicago high school boys. Then came the war and interest was directed elsewhere.

Then Lindbergh's epochal flight in May, 1927, and overnight America became airminded. Prior to this time, the toy aircraft industry had been very small indeed, but in the next three months it jumped to a quarter of a million dollars retail. By the end of 1928 it had climbed close to the 2,000,000 dollar mark, wholesale, while the Metalcraft Corporation, in October, 1929, wholesaled some 140,000 dollars, as has been noted, in demountable aluminum and sheet-steel aircraft parts for toy models.

The paint room. The carrier dips low so that the toy airplane parts are immersed in the paint

Meantime the Playground and Recreation Association of America got behind a movement to arouse juvenile interest in aircraft construction, sponsoring miniature aircraft tournaments all over the country, with a National Tournament held in Memphis, Tennessee, in October, 1927. The vocational departments of many public schools had already adopted a definite program of model airplane construction, with classes, contests, and the like.

Nor has this work been confined to any one type of plane. Flying stick types, scale models of famous ships, hydroplanes that will rise off the water, and racing planes driven by four propellers and capable of running 50 miles per hour, have been constructed.

The National Aeronautical Association has recognized two of these contests, held annually: the Mulvihill for outdoor models, and the William B. Stout for indoor models named after the donors of the trophies.

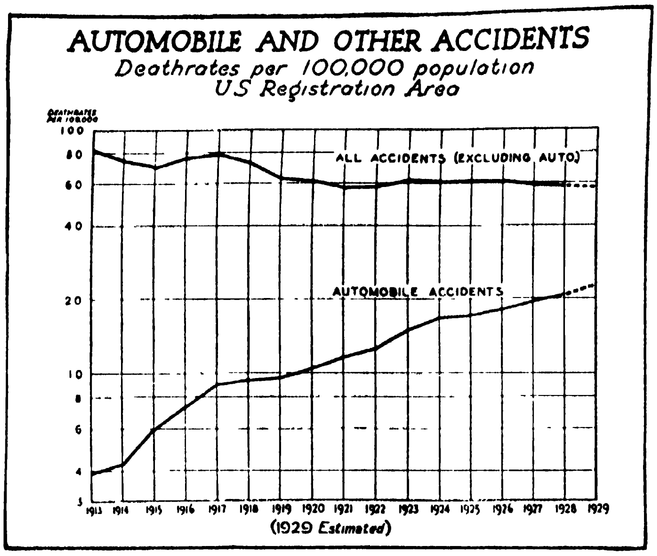
Illustrations courtesy The Metalcraft Corporation

Assembling and packing the finished parts in construction sets. The purchaser does the final assembling himself, from the parts supplied in the kit

IN June, 1928, the National Indoor Meet was held in Detroit, with boys from all over the country competing for the Stout trophy and some 500 dollars in prizes. It is significant to note that during the World's Air Fair Week, held in the St. Louis Arena during the middle of last February, a National Junior Indoor Model Airplane Contest was held; also, steps were taken for the organization of the first Junior Aircraft Convention, at which time technical subjects as applied to model airplane construction will be up for discussion.

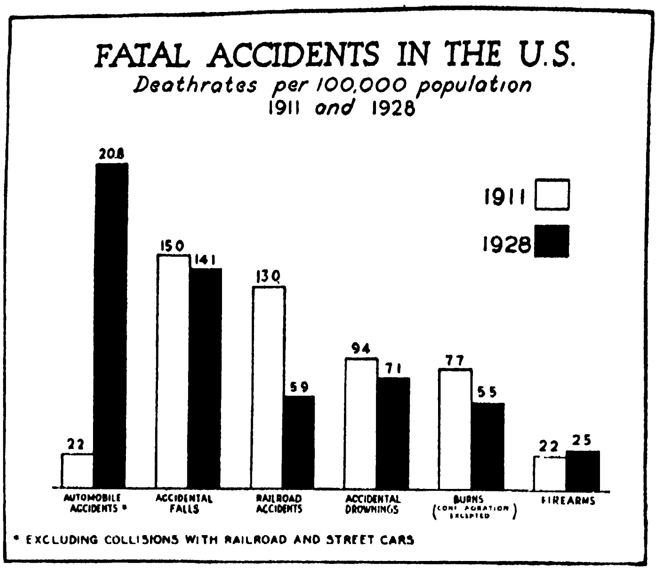
From Florida to Newfoundland, and from New York to Seattle, these model airplane contests are being held. They are being fostered everywhere; special junior technical aircraft magazines—featuring model drawings to scale, for the boy to use in his construction work—have made their appearance.

And the whole of it points directly toward a highly specialized aircraft education for boys—not just haphazard play! The results are bound to be far-reaching in the extreme in their effects upon the aviation of tomorrow.

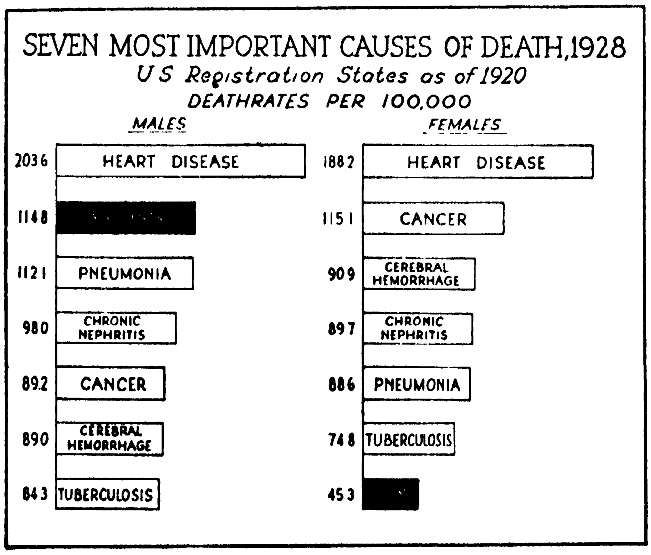


All diagrams courtesy of National Safety Council

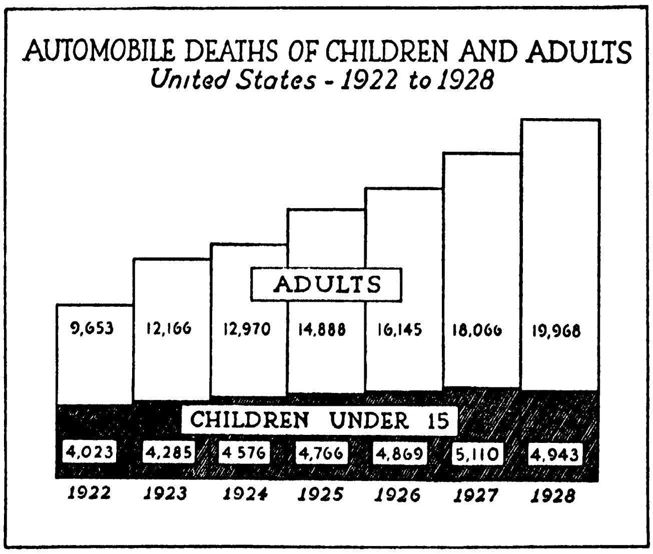
While automobile accidents soar, the death rate for non-automobile accidents is 30 percent below 1913



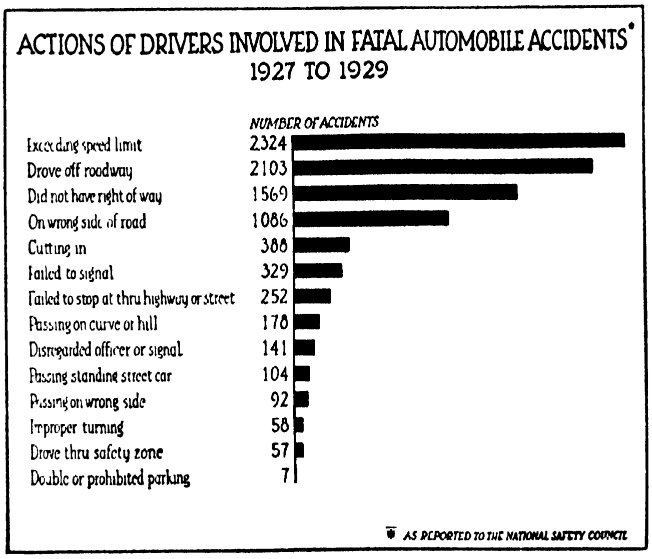
Various types of accidental death, showing a decrease during 17 years except for automobiles and firearms



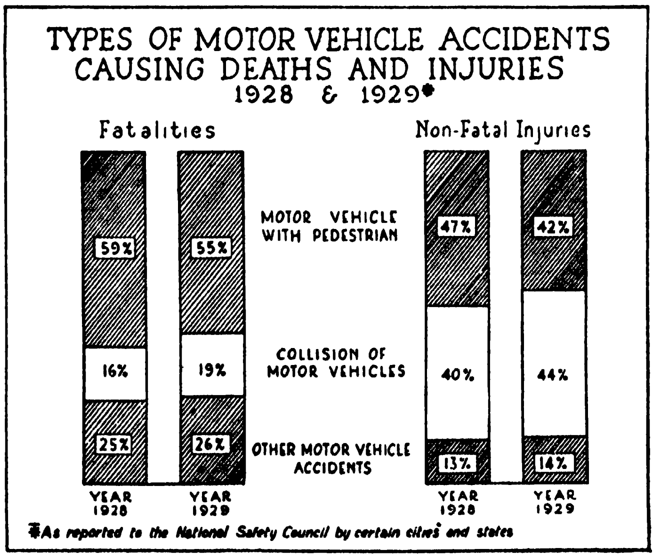
Fewer women than men suffer accidents. Accident death rates compare unfavorably with those of disease



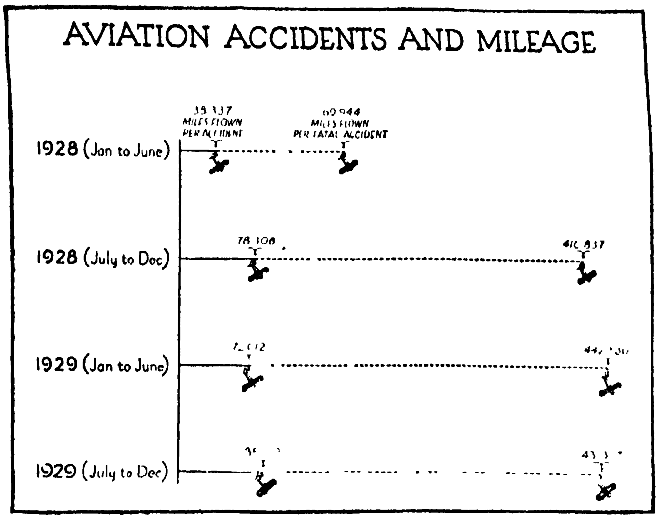
Motor vehicle deaths among persons over fifteen years old are increasing more rapidly than among children



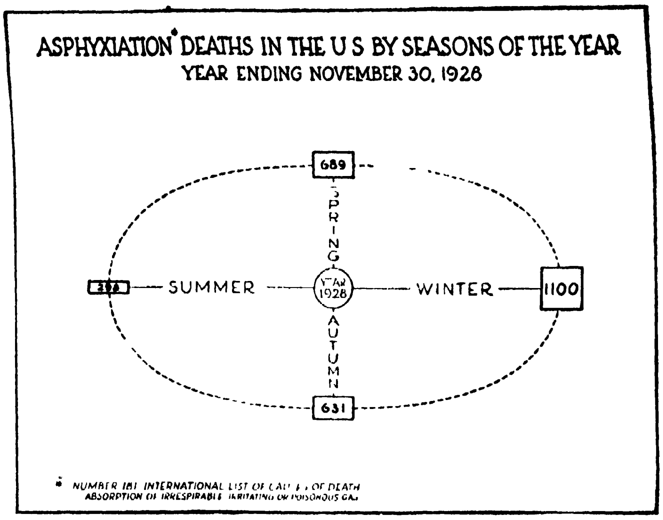
The cause of automobile accidents is worth studying. Speeding tops the list but even parking adds its quota



This interesting diagram shows that the automobile kills 13 percent oftener than it injures the pedestrian



Aviation accidents are on the increase as is described in the text. Four hundred and ninety-six deaths occurred in the year 1928 by airplane and balloon



The third largest cause of home fatalities is asphyxiation; 40 percent of such deaths occur in the winter months. The number is far smaller in the summer

The Penalty of Carelessness

AN unprecedented increase in motor vehicle fatalities overbalanced the decreases in all other walks of life last year and America's accidental death toll rose to a new high total of 97,000. The private automobile driver is responsible for most of this increase and he must be curbed before a definite reduction can be realized in the national accident picture. The 1929 total for all accidents has just been made public by the National Safety Council on completion of its accident analysis for the past year. The accident fatalities for 1928 were 95,086. While total fatalities in 1929 were slightly less than 2000 more than in 1928, automobile casualties alone reached 31,000, an increase of 3000 over the previous year. These figures tend to show that motor vehicle fatalities alone are on the increase and that other types of accidental deaths are on the gradual decline.

Accidents to children are increasing far less rapidly than to older persons. In the seven-year period from 1922 to 1928, fatalities to persons of all ages increased almost 25 percent. In the same period accidental deaths of children under 15 increased less than one tenth of 1 percent. If accident prevention work among adults had been as successful as among children, approximately 20,000 lives would have been saved during the past year.

There was very little change in the railroad-automobile fatalities during 1929 and there was an improvement in the accident situation among commercial vehicle drivers. A large part of the increase therefore can be charged indirectly to careless owners of private automobiles.

The 97,000 death toll for 1929 included 23,000 fatalities in or about American homes; 23,000 fatal accidents in industry; and still another 20,000 persons who lost their lives in public accidents not involving the use of a motor vehicle. The principal cause of home accidents was falls, 9200 persons losing their lives in this manner. Burns, scalds, and explosions accounted for the next largest number of home fatalities. Asphyxiation and suffocation were the third most important causes. Carbon monoxide poisoning in closed garages was an important contributing factor. About 200 non-fatal accidents occurred in American homes for every fatal accident, it is estimated.

IN addition to the annual study of accident statistics of the United States for the past year the National Safety Council conducted an interesting survey. Inquiries were sent to all governors, to the mayor of every large city, and to numerous other officials and civic leaders, asking their opinions as to the reason for increases or decreases in last year's accidents. Personal studies were made in 12 leading cities. This survey brings out some interesting facts: The states which have rigid drivers' license requirements continue to make better records, in relation to their own past experience, than the states where licenses are not required. Speed is a major consideration in the opinion of quite a number of the state and city officials and other experts. Intoxication is partly responsible for the "obsession to speed," according to the reports. Inadequate enforcement is blamed by many authorities.

There is one hopeful sign brought out in the analysis of the accident experience for 1929. If we could ignore the annual toll from motor vehicle accidents, our national experience would show that the national death rate from all other accidents had been reduced more than 30 percent since 1913.

The number of airplane and balloon fatalities in the United States has increased from 182 in 1920 to 496 in 1928. These are the Census Bureau figures. The Aeronautics Branch of the United States Department of Commerce recorded a total for the year of 485 fatalities in civil aviation. Schedule flying has the best record with a total of only 41 fatalities, or 8.5 percent of the total. According to other reports of the Aeronautics Branch, this type of aviation accounted for over 25,000,000 miles flown out of a total for all types of 79,000,000, or 31.6 percent of the total mileage. Miscellaneous pleasure flying resulted in 277 fatalities, or 57 percent of the total for all types. Of the total fatalities 227 were pilots and 258 passengers. The average mileage flown per accident and separately, per accidental fatality, is shown in our diagram. After extended and careful investigation the Aeronautics Branch announces that in 1929 about 57 percent of all accidents were due to errors of personnel; 18 percent to power-plant failures and 10 percent to some failure in the machine apart from the power-plant. Less than 5 percent were attributed to weather conditions. There was a sharp increase in deaths in airplane accidents in 1927 and a still greater advance in 1928, the latter being over 100 percent.

A quicksilver, or mercury, mine located in the hills of Nevada

The Reviving Liquid-Metal Industry

By J. K. NOVINS

IMAGINE a radio set without a vacuum tube, Milady's vanity dresser without its vermillion cosmetic, the bathroom chest without its reserve of mercury bichloride to guard against fleshy infection, the sick room without a thermometer, and your hunting ammunition unequipped with precussion caps. All of these utilize quicksilver, or mercury, in various quantities. Yet the average man or woman knows little of the origin of this liquid metal or of the methods through which it is extracted from sandstone and poured into flasks, ready for the many uses that man's scientific ingenuity has devised.

Still less do we know of the potential uses of this fluid-metal which touches the life of every man, woman, and child in that it brings freedom from agonizing pain, makes possible home comforts, kills crop-destroying insects, prevents the fouling of ship bottoms, and is used extensively to roughen the hairs of felt products.

Of the two and a quarter million pounds of mercury utilized in this country, only 10 percent enters into the manufacture of electrical apparatus. Yet here is a field that promises unprecedented demand for the metal and is responsible for the present revival in mercury mining. Few know that mercury is essential in the manufacture of neon lights which are now used for display sign purposes. The blue color produced by the neon sign is caused by the presence in the tube of metallic mercury which acts with the neon gas. The green color is produced by mercury without the aid of any other gas or chemical, but the glass tube is tinted.

Of greater importance still is the promised use of mercury in power generation. Experiments conducted by the General Electric Company have demonstrated that mercury turbines have a heat efficiency of 85 percent, as compared to the 25 percent or lower heat efficiency of steam electric plants. If applied generally, anywhere from 11,000,000 to 17,000,000 pounds of mercury would be required to take care of the annual increase in generator capacity. This amount of mercury is more than the entire world now produces annually.

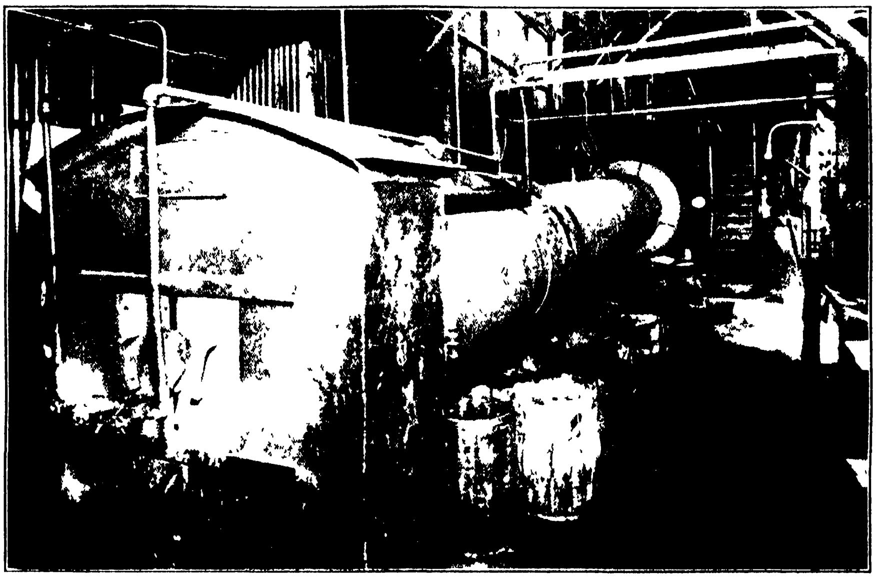
THE experimental installation consists of a mercury boiler and mercury-vapor driven turbine, as well as steam boiler and steam-driven turbine. After passing through the vapor-driven turbine, the mercury vapor is condensed. Steam is generated in this condenser by the heat delivered in the condensation of the exhaust mercury-vapor. The condensed mercury is then drained and returned to the mercury boiler. In this manner mercury can be utilized with very little loss.

Only 2.4 percent of the mercury used in this country enters into the manufacture of scientific instruments, such as thermometers and barometers. By far the largest amount—to be exact 32.2 percent—is required by the drug and chemical industries. The largest single use is for fulminate, an explosive, and next in order, for vermillion and oxide. Only a little over 3 percent is used for gold and silver milling, although during the bonanza days in gold mining very large quantities of mercury were needed to amalgamate gold and silver from the metallic ores. In the heyday of gold mining, California, which is our largest mercury producing state, enjoyed a record annual production amounting to 4,000,000 dollars, but now the production has fallen to less than a million. For many years the domestic mercury industry was practically at a standstill, only to be revived recently by increasing demands in industry.

A NUMBER of the old mercury mines in California, which have been idle for years, are now thriving with renewed activity. The Oat Hill Mine, which the writer visited recently, again began to produce the metal from low-grade ore only a few months ago, after it had been abandoned for four or five years. Low prices, substitution of cyanide for gold and silver extraction, and the competition of foreign mines, were responsible for almost a dead stop in domestic production. No other metal has suffered as much from the inroads of substitution. It was formerly used in large quantities to "silver" mirrors, but is now almost entirely replaced by a silver nitrate process. Even as a fulminate, other substitutes have been found, in which lead and silver form the principal products. Now that mercury has been demonstrated as an efficient power generation agent, research has revealed a suitable substitute for it in the form of diphenyl oxide, which is a by-product in the manufacture of carbon tetrachloride and chloroform.

YET, despite its age-long battle with substitutes, mercury has persisted as a separate mining industry since the Phoenicians first began to work the famous Almaden Mine 27 centuries ago. Today this mine, operated by the Spanish government, produces more than one third of the world's supply of mercury, and shows no signs of depletion. Last year this mine produced half of the world's supply. Italy was the next largest producer, and the United States came third in the production of this metal.

The principal mercury mines in California are located without exception in the coast range, where the ore has been lifted toward the surface by volcanic action. The mines are usually located in the vicinity of hot springs. Due to the surface operations, mercury mining in California has not been marked by the hazards of fissure digging in the Almaden deposits, where men have gone to depths of several thousand feet. Due to the greater heat at 2000 and 3000 feet below the surface, mercury has been known to run down the stope walls as so much liquid, thereby subjecting the miners to the danger of mercurial poisoning.



View of a Gould rotary furnace, a type now used extensively for the refining of mercury. Its rotating action helps volatilize the mercury in the ore. Its construction and operation are described below

From the cyclone tank, on which stands a man, mercury vapors are piped into condensers

Surface mining, confined largely to depths of several hundred feet, have tended to reduce hazards, and the danger of poisoning by contact with vapor has been largely eliminated by the use of modern furnace and condensing equipment to be found in the California mines.

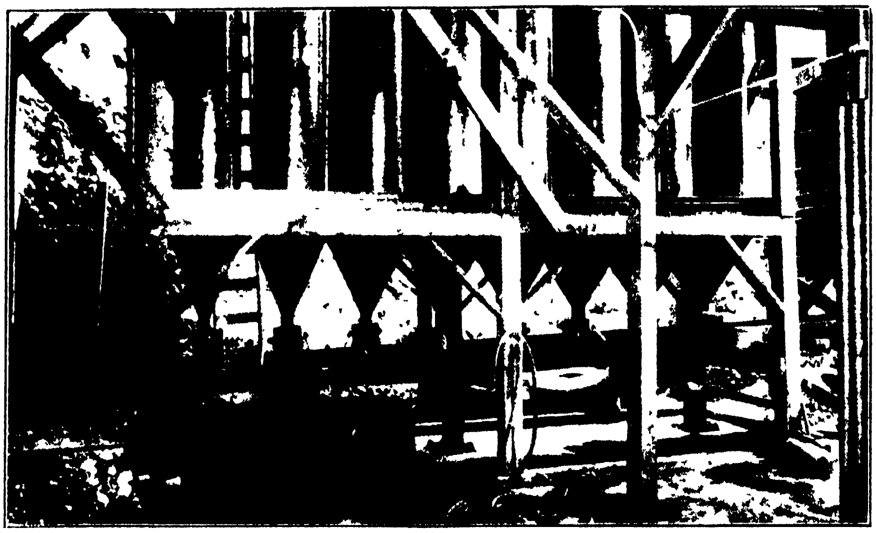
At the Oat Hill Mine, tunnels are bored into the hillside and the ore removed to the surface on a narrow-gage roadway. The ore is a sandstone dotted with red, and is known technically as cinnabar. This heavy, vermillion-colored mineral is composed largely of mercury and a smaller amount of sulfur. The process of extracting the mercury is a simple one, the metal being distilled by heating the ore until the mercury vaporizes and then condensing the vapor into a liquid. This is followed by a purification process to get rid of the sulfur, as well as of carbon monoxide gas and other dangerous fumes. The final process is to "hoe" the mercury from its slimy blanket of soot. The refining process is accomplished entirely at the mine, and takes place within a few minutes after delivery of the crushed ore to the furnace.

In mercury mining, a tunnel is driven to as great a depth as 750 feet. There are innumerable tunnels to be found in the vicinity of the Oat Hill Mine, and it is estimated that in the 60 years that this mine has been producing the metal no less than 24 miles of tunnel have been driven. During that time the Oat Hill Mine has produced some 19,000,000 dollars worth of the widely used liquid metal.

From the mouth of the tunnel, the ore rock is conveyed to the gravity sorting bin by a three-ton motor truck. After a perilous mile and a half trip over a one-way mountain road, the truck is backed up onto a loading platform, from which the rock is catapulted several hundred feet to the storage bin below. Yet this truckload of rock will produce only 12 or 18 pounds of mercury, figured at from four to six pounds of the metal to the ton of ore. At present prices—and they are high—a pound will bring less than two dollars, or more than double the production cost. The present price is treble the average price of mercury in the United States during the past 40 years, while production cost has been reduced by utilizing more efficient production methods.

BEFORE the ore is fed to the furnace, it must be crushed and sorted. An automatic feeder introduces the ore particles into the rotary furnace at the rate of 10 pounds every minute. The feeder can be adjusted to feed the ore in various quantities and in different sizes, depending on both the type of ore and the roasting conditions. The "feed" then has to go through the 60-foot rotary furnace, which slowly revolves in order to facilitate volatilization of the mercury from the ore. At the point that the ore enters the furnace a temperature of 1800 degrees, Fahrenheit, is maintained, this being decreased to 450 degrees at the mouth of the furnace.

The rotary furnace turns three fourths of a revolution per minute and inclines at three fourths of an inch to the foot. At the same time that the vapor rises from the ore, the revolving action raises the dust as the rock proceeds downward. A powerful fan in



Mercury condensing system. The vapor travels through these condensing tanks and is deposited as a sort of sludge or slime in the hoppers below

the dust chamber at the head of the furnace sucks the vapor and dust into two cyclone tanks, in which the dust settles and the mercury vapor is made to proceed to the series of 12 condensers. The first cyclone tank is smallest and collects most of the dust. As the dust and vapor enter the cyclone they are driven by centrifugal action from the center to the metallic walls, with the result that the dust, being heavier, will settle, while the vapor, combined with smaller quantities of dust, will undergo further separation in the second, and larger cyclone. The light gaseous vapor naturally rises to the top of the tank directly into pipes which lead to the series of condensers.

The condensers are 16 feet long and 19 inches in diameter. At the bottom of each condenser unit is a cone-shaped outlet. The hot gas enters directly into this lower cone, where it deposits some of its dust, and then travels through a circular pipe to the height of the condenser. The vapor condenses into the familiar liquid against the cool walls, and this liquid metal drops to the cone-shaped hopper, or outlet.

A CERTAIN amount of the condensed mercury will adhere to the wall and can be removed into the hopper below by unscrewing the clean-out hole at the top of the condenser and flushing the walls with water. Even at this stage the mercury can be removed from the hopper in the first condenser in the form of a whitish slime from which the quicksilver must be hoed out.

A certain proportion of the mercury vapor will fail to condense in the first condenser, and will therefore circulate through the other condensers in the series. Experience has shown that most of the mercury will be deposited in the second and third hoppers. The complete series of 12 condensers is needed in order to catch every minute globule of mercury before the sulfur and other gases are afforded an escape to the purifying tanks.

The three purifying tanks are connected by a small pipe. Thus by a process of compression, when the gases enter the pipes, and by expansion during the journey in the tanks, considerable heat is generated, propelling the sulfur and carbon monoxide gases to the stack, from which they are vented into the air.

The whitish slime gathered from the hoppers is dumped on a round table. A man with a hoe separates small quantities of the slime, and as he does so, small streams of mercury globules are seen to flow to the opening on the lower end of the table and into a metallic flask which normally holds 76 pounds of mercury. Properly sealed, this flask is ready for the market.

The hoeing process is a survival of ancient times. The minute globules of mercury present in the slime are practically invisible to the naked eye. The action of the hoe loosens the slime in small quantities, making it possible for the small globules to seek each other out, much as drops of water coalesce into a small stream. It is the simplest, yet most interesting process of mercury refining—and the most hazardous.

The hoeing action must be slow; otherwise it will raise little eddies of dust, which if swallowed, even in minute particles, is sure to cause mercurial poisoning. The first symptom of the poisoning is loosening of the teeth, followed by disruption of the digestive system. If the poisoning is not arrested, the operator will suffer an attack of nerves. Leaky pipes in the roasting and condensing system are now the chief cause of poisoning. In the ancient Almaden mines there were so many cases of poisoning that the occupation was considered too dangerous for a free man; therefore convict labor was extensively employed.

H. W. GOULD, a San Francisco mining engineer, recently perfected a mechanical hoeing device which it is expected will eliminate the inefficiency and the hazards of hand hoeing. This device is equipped with mechanical rabble arms to separate the slime and afford free movement for the mercury globules. Mr. Gould is also the inventor of the rotary furnace which is now used extensively in American mercury mines, and is gradually replacing the older methods employed in foreign operations. It is especially adapted for low-grade ores which formerly could not be worked at a profit. At the Oat Hill Mine the rotary converts 80 tons of ore every 24 hours. This ore has less than 0.25 percent of quicksilver. At the Spanish mines the ore has about 8 percent of mercury and can, therefore, be mined economically with the older methods of refining. Although these mines have been worked since 800 B.C., richer ore is now being extracted from great depths.

Paul M. Tyler, of the Federal Bureau of Mines, says that "in many lines, substitutes for mercury are employed; but in other lines there is a constant ebb and flow as consumers experiment with first one and then another, only to return to mercury.... To have faith in the future of modern industry is to have confidence in the future of mercury."

Waste ore from the furnace is deposited in a retort and is removed in carts to the rock dump

PROHIBITION

and the Physiological Effects of Alcohol

By H. H. MITCHELL

Professor of Animal Nutrition, College of Agriculture, University of Illinois

THE most acute political question of this generation is at the present time being debated largely on the basis of uncertain statistics, and interpretations of them biased by inflexible opinions in regard to moral standards or personal liberty. It should be obvious to those who approach the question of the advisability of national prohibition with an open mind that reliable statistics on the success of prohibition enforcement are not at hand. The interpretation of trends in penal, industrial, and other social statistics that are at hand, in terms of assumed trends in the consumption of alcoholic liquors nevertheless is the stock in trade of the political prohibitionist and the political anti-prohibitionist. After reading the propaganda put out by both sides of the argument, one can agree wholeheartedly with Josh Billings, when he said that it is better not to know so much than to know so many things that aren't so.

THE enactment of legislation aiming at the restriction of the sale of alcoholic liquors can be justified only on the basis of the harmful effects of alcohol on the human body and on human behavior. The extent to which the consumption of liquor should be restricted depends upon how harmful alcohol is and in what dilution its effects become inappreciable. Few would doubt the wisdom of governmental restriction of the sale of the alkaloidal narcotics. The question with respect to alcohol may and should be argued on the same basis, though the answer need not be the same because there are certain compensations in the use of alcoholic beverages that do not pertain to the use of the more powerful narcotic drugs. Without minimizing the importance of the purely practical problems of the probable effectiveness of the machinery for the enforcement of liquor legislation and of the expense involved, it appears to be no exaggeration to say that the purpose and the form of such legislation should be determined largely on the basis of scientific data in regard to the physiological and psychological effects of alcohol.

How does the human body dispose of the alcohol contained in consumed liquor? Requiring no digestion and being readily soluble in water and readily diffusible, it is rapidly absorbed from the digestive tract. In fact, absorption may start in the stomach, from which practically no absorption of the ordinary food nutrients occurs. The absorbed alcohol is taken up by the blood stream and carried to all the tissues of the body. Its ready diffusibility in aqueous media accounts for its penetration into all organs, and after a time it may be present in the brain, liver, kidneys, spleen, heart, and lungs in concentrations approximating that in the blood. Even after moderate doses of alcohol, it may be detected in the expired air, in the urine, and, with nursing women, in the milk secreted.

OF heated articles about prohibition there already have been no end. It may be stated with fair confidence that 90 percent of the general public is thoroughly and heartily sick and tired of them. It is getting so that many people, when they sense the approach, say at dinner, of an oral tilt about this threadbare subject, let out a groan of despair and slide into oblivion under the table. At least they feel like doing so.

Is it not possible that this widespread reaction to the prohibition question is due partly to the fact that one so seldom reads an article or listens to an argument on prohibition that seems really calm and unbiased? But we publish Professor Mitchell's article because we believe it is just that—calm and unbiased. If as a result of its publication we receive a half bushel of letters saying it leans toward the "Demon Rum," and another half bushel saying it leans equally in the opposite direction, our own belief — that it does not lean at all —will be flattered.—*The Editor.*

But the body does not dispose of ingested alcohol to any great extent by excretion from lungs or kidneys. Only five percent or less is gotten rid of in this way. Alcohol is combustible in the body, and is very readily burned to carbonic acid and water, as are sugars and fats. The energy thus liberated may be used by the body in the same way and for much the same purposes as the energy produced from the burning of sugars and fats. But it has not been shown that alcohol can be transformed to sugars or fats and stored in the body.

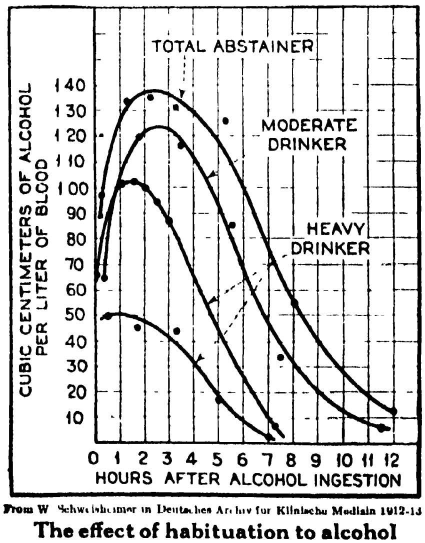
Hence, after a drink of alcoholic liquor the concentration of alcohol in the blood and tissues will rapidly rise to a maximum in the course of one to two hours, depending on the concentration in the liquor consumed, but then it will gradually decrease until after a variable period of time the body will be alcohol-free or practically so. It has been estimated by Mellanby in England, that an average man can burn only from 7 to 10 cubic centimeters of alcohol per hour, so that the time required for the body to rid itself of this substance will be directly dependent upon the amount consumed. A moderate dosage of alcohol, for example, 30 cubic centimeters or approximately one fluid ounce, contained in a pint of fairly heavy beer, would be disposed of in three to four hours or so, but an intoxicating dose may take from 10 to 20 hours for complete combustion.

THE physiological and psychological effects of alcohol have been shown to vary in intensity with the concentration of alcohol in the blood. When the blood contains no more than 0.1 percent of alcohol there are no obvious signs of intoxication. A concentration of .15 percent of alcohol, following the consumption of about 100 cubic centimeters of alcohol (4 pints of beer or 7 to 8 ounces of whisky) on an empty stomach, is associated with a moderate state of intoxication. With increasing consumption of alcohol the maximum concentration in the blood will increase to 0.5 percent, which may be associated with stupor. When a concentration of 0.6 percent is reached, life itself is endangered. Some recent German investigations, in which more recent methods for the analysis of blood for alcohol were used, would indicate that these values may all be low, but the fact remains that alcoholic effects are correlated with alcohol concentrations in the blood, and that the lethal concentration is uncomfortably close to that associated with alcoholic stupor.

It is well known that the effects of a given dose of alcohol depend upon its dilution as consumed. More alcohol may be consumed in dilute solution than in concentrated solution in producing a given physiological effect, because the time of absorption is extended. In agreement with this fact, it has been found that the more concentrated the solution of alcohol consumed, the greater the blood concentration attained and the quicker the maximum concentration is reached. Vernon has shown, in illustration of the same relation, that amounts of alcohol may be consumed in small hourly doses without physiological effect, which in the aggregate would produce intoxication.

It is also well-known that the consumption of alcoholic liquor during or immediately after a meal produces a much smaller psychic effect than consumption on an empty stomach, for example, three hours or more after a meal. A number of investigations agree in showing that the alcoholic content of the blood is less if a given dose of liquor is drunk immediately after a meal than three or more hours after. The consumed alcohol mixes with the food in the stomach and is diluted by it, so that the rate of absorption in considerably less. Fatty foods are particularly effective in this respect.

Again, it is a matter of common experience that a person not accustomed to alcoholic liquor is more readily affected by it than is a habitual user. And again the blood picture offers an explanation. Thus, Schweisheimer showed that if total abstainers, moderate drinkers, and heavy drinkers imbibe the same quantity of alcohol under the same conditions of dilution and time after the last meal, the resulting concentration of alcohol in the blood is highest for the abstainer and lowest for the habitual heavy drinker. Furthermore, the observed differences were considerable. Possibly the habitual consumption of alcoholic liquors impairs the absorptive powers of the digestive apparatus, or possibly some obscure protective mechanism is developed.



From W. Schweisheimer in Deutsches Archiv fur Klinische Medizin 1912-13

The effect of habituation to alcohol on the concentration of alcohol in the blood after the ingestion of 1.57 cc. per kilogram of body weight (corresponding to about four ounces for a 150-pound man)

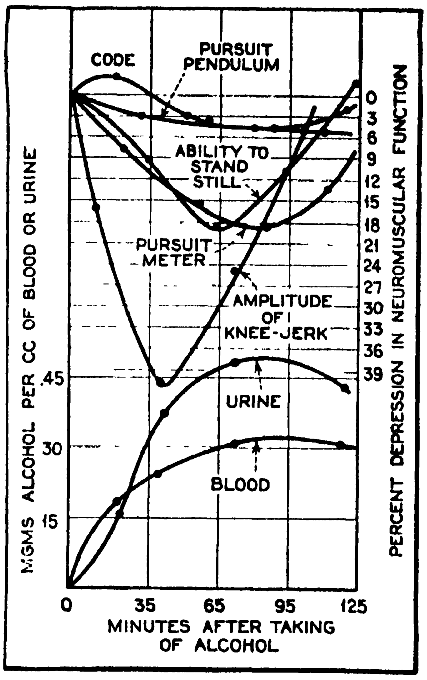
It is true that alcohol is a food in the sense that it is easily oxidized in the body, but unlike the ordinary nutrients it is toxic when it attains even a moderate concentration in the blood and tissues. Also unlike ordinary nutrients, the body has no effective means of regulating its concentration in the blood. When a healthy normal person consumes sugar or starch, even in large amounts, the concentration of sugar in the blood will rise rapidly, but when the rate of absorption exceeds the rate of oxidation and sugar begins to accumulate in the blood, it is withdrawn from the blood by the liver and the muscles, converted into glycogen or fat and stored for future use. The concentration of sugar in the blood will for this reason rarely exceed 0.15 percent. But in the diabetic, who has lost the power to oxidize sugar or to store it in any considerable amount, the consumption of sugars and starches will increase the concentration of sugar in the blood to 0.30 percent or more, and the accumulated sugar clogs the physiological machinery, so that diabetic coma and even death may result.

There is thus a similarity between the effects of sugars and starches on persons afflicted with diabetes and the effect of alcohol on normal persons. The diabetic can dispose of absorbed sugar only (or mainly) by way of the kidneys; the normal individual can dispose of alcohol only (or mainly) by way of oxidation, but in both cases the mechanism of disposal is effective only to a certain limit of consumption, beyond which increasingly disastrous effects will ensue, even to the point of death. Thus, regulation of the composition of the blood in neither case is a physiological one, but is largely a matter of voluntary control. However, the diabetic is aware of his condition and of his own peculiar dietetic dangers, and trains himself under medical guidance to limit his consumption of dangerous foods to his own particular tolerance for them. Can the same be said of the habitual drinker?

The outward symptoms of alcoholism are familiar to all, but it is of interest to quote a precise description of them as analyzed by a noted English physiologist, the late Professor E. H. Starling:

"The effects of acute alcoholic poisoning may be described as a continuous and progressive impairment and abolition of the functions of the brain, starting at the highest evolutionary level and progressing downwards. The stage in which there is lessened self-criticism, greater freedom of utterance, and diminished self-control is succeeded by a phase in which there is interference with the social habits of the individual, while the co-ordination of muscular movements becomes more and more imperfect. This gives place to a condition of stupor or drunken sleep in which the individual may persist for many hours until the greater part of the alcohol has been oxidized in the tissues and its concentration sinks once more below the poisonous level. In the drunken sleep the noisy, labored breathing often shows the beginning of interference with the innervation of the respiratory muscles, and if the dose has been sufficiently large this mav lead to death from paralysis of respiration. . . . In some cases the result may be a profound shock from the direct irritant effects of the strong alcohol on the stomach, and heart failure may be associated with the gradual failure of respiration."

Popular opinion throughout the



Data from Miles, Alcohol and Human Efficiency

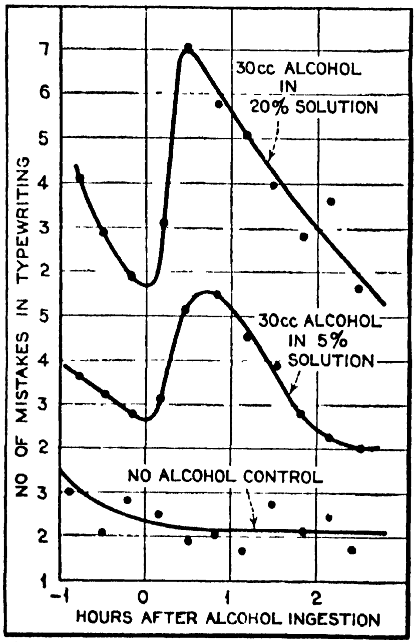
Effect of a small dose (27.5 grams—about an ounce) of alcohol in dilute solution (2.75 percent) on selected neuromuscular responses and the alcohol content of blood and urine. The curves represent averages from eight subjects. The neuromuscular responses may be described briefly as follows: Efficiency of eye-hand co-ordination was tested by the "pursuit pendulum," with which the subject catches in a small cup as much as possible of a stream of water flowing from the lower end of a moving hollow pendulum. Continuous eye-hand co-ordination was measured by the pursuit meter, an electrical instrument of some complexity—the subject, by manipulating a rheostat, endeavors constantly to keep a wattmeter needle on the zero-mark in spite of fluctuations in the electric circuit automatically induced by a disturbing device which remains beyond his control

civilized world favors some type of governmental action to decrease the likelihood of alcoholic intoxication, a condition which is disgusting to see and degrading to its victims. The pleasing effects of alcohol are, however, realized long before this condition is reached. The temperate use of alcoholic liquors induces a condition that has been sympathetically described, also by Starling. Picturing a man who is attending a feast of which alcoholic drinks form an integral part, Starling says:

"A man may go to such a dinner full of the cares and work of the day, with little or no interest in those he has to meet, whose occupations may be very diverse from his own, nervous of making any remarks to his neighbors for fear of making himself ridiculous or saying something in which they are not interested. After the first glass of champagne we notice the conversation, instead of being spasmodic and forced, becomes general and free; the self-consciousness and preoccupation of each man with his own affairs become lessened. He is more receptive of the moods and interests of his companions. His emotional responses are more readily aroused; the solemn man unbends, the critical becomes charitable and sympathetic, the silent man more loquacious. Each man thus not only reveals himself more to his fellows, but is more ready to appreciate the merits and conversation of those around him. In a word, the use of alcohol in moderation promotes good fellowship. With this greater freedom of interchange of ideas there is less restraint of gesture; facial expressions become more animated; ideas in every man seem to flow more freely and speech becomes more ready."

EVEN though at such a feast, a second or a third glass of champagne may change the conversation from witty repartee to boresome anecdotes and maudlin expansiveness, there is surely no occasion for the interference of organized society. But when the party breaks up and its members enter their various automobiles for the trip home, possibly through congested traffic, have their psychological reactions and their muscular co-ordinations been so adversely affected that as motorists they are to some degree menaces to public safety? Or if it is a midday meal, and they have an afternoon of work in office, shop, or factory before them, have their physical and mental efficiencies been impaired by this convivial feast?

Unfortunately these questions must be answered in the affirmative. Many physiological laboratories throughout the world, particularly the Nutrition Laboratory of the Carnegie Institution at Boston, have demonstrated beyond reasonable doubt that the consumption of even moderate amounts of alcohol, in dilutions of 10 percent to as low as 2.75 percent, depresses the function of the nervous system generally and in many respects to an appreciable and even a considerable extent. It is true that much of this work relates to drinking between meals rather than at meals, but the results are applicable, if in less degree, to the case in point. Furthermore, it may be supposed that wherever the desirable psychic effects of alcohol are observed, the depressant effects are invariable accompaniments, since both must result from an increased concentration of alcohol in blood and tissues.



From Report No. 31 Medical Research Committee (Great Britain)

The effect of 30 cc. (about an ounce) of alcohol, taken in dilutions of 5 and 20 percent, on the accuracy of typing a memorized short passage, which required a maximum of two minutes to type

If a participant of Starling's feast attempts to stand perfectly still, the swaying of his body may be greater by almost one fourth than it was before the feast; if he attempts to follow with his eye a quickly moving object, or if he attempts to adjust some instrument with his hand according to the guidance of his eye, his performance will be definitely subnormal. His visual acuity has been decreased and the amplitude of his knee jerk (patellar reflex) has been depressed. If he is a skilled typist, his speed in typewriting will be to some extent lowered and the number of errors perpetrated will be greatly increased. In the case of a woman, her speed in threading needles will be much less than normal. In these and many other ways, it has been shown that alcohol in very moderate doses is a depressant, though the imbiber will have the subjective impression that he is performing faster and better than normal. The more skilled the task, the greater is the depression in efficiency.

It is very doubtful whether alcohol ever exerts even a small initial stimulating effect on the nervous system, as has been maintained in the past. The change in point of view has resulted from improved methods of study. It is now recognized that many physiological processes are normally kept slowed down by higher controlling centers. When these centers are depressed by alcohol, or ether, or chloroform, the lower mechanisms are released with some of the signs of stimulation, such as an increased pulse, or a flushing of the surface capillaries with an increased flow of blood. The effect resembles that following releasing the brakes of an automobile, as contrasted with increasing the pressure on the accelerator. A British scientific board has summed up the evidence in the statement that "the direct effect of alcohol upon the nervous system is, in all stages and upon all parts of the system, to depress or suspend its functions; that it is, in short, from first to last, a narcotic drug."

THESE scientific findings render superfluous any statistical inquiry of the effects of alcohol consumption on industrial efficiency. A depression of efficiency of some degree is almost an inevitable consequence of even the moderate use of alcohol. The effect upon criminal tendencies can not be so clearly deduced, but the common association of liquor with crime, even before the prohibition regime, must be something more than an accidental one. In so far as the criminal is a psychopath, with an inherited tendency to mental and nervous instability, he is, according to Starling, an especially susceptible victim of alcoholic poisoning.

The facts discussed in this article are not presented as the sole evidence upon which the wisdom of prohibition should be decided. But it may be contended that they should form an important part of that evidence. The basis of discussion of this question should be shifted from the grounds of morality, social reform, and personal liberty, which possess merely a sentimental appeal, to the sounder basis of the control of the sale of alcohol as a narcotic drug. Its potency is much less than that of other drugs long known to be narcotics, but the much more prevalent use of alcohol in much greater amounts will of necessity occasion more misery, ill-health, and inefficiency. However, the use of alcoholic liquors by a large proportion of the population is a striking testimonial to its contribution to the pleasures of life and to conviviality. The solution of the question of liquor control should possibly be a compromise between these opposing arguments.

One of the studios where recorded radio programs are made. Two microphones are visible, one on each side of the window in the background

Recorded Radio Programs

By A. J. KENDRICK

President, Sound Studios of New York, Inc

IN England the broadcast program is paid for by the public, which is taxed, the money collected being turned over to the radio stations to defray the expenses of broadcasting. The sponsored program does not exist.

In this country, however, business interests, awake to the good-will that may be created for their products and services via the air, pay the stations for the privilege of broadcasting programs. The sponsor also pays for the programs, which entertain the radio public and create good-will for the sponsor. This American system of broadcasting, which makes of radio a business asset, has also introduced a new industry to take the place of that older one which has found the going hard in the face of radio competition. The old industry to which we refer is that of making phonograph records. The new one is the recording of broadcast programs.

It might appear that these two industries are quite alike. They are—in outward respects. The new one has grown from the older. But the new one has progressed to that point where a person familiar only with the old method of phonographic recording would be lost in the new science of recording radio programs. On the other hand, those who would do fine work in the new industry should have at their command experience in the phonograph field, should have grown up hand in hand with recording, from its primitive days to the present time.

It was with the basic idea of creating an organization based on quality that Sound Studios of New York was founded. With Gustave Haenschen and Frank Black, well known in the phonograph and radio worlds, as Vice Presidents and directors of music, we were assured of artistic programs that would please the audience and gain good-will for the sponsors. With C. Lauda, Jr., an authority on acoustics, as Chief Engineer, we were well taken care of on the technical end, especially since he immediately surrounded himself with experts to handle every phase of recording.

THEN we procured studios and equipment of the latest type. Desiring to have full responsibility over every step in the making of recordings, we acquired turntables and recorders, microphones and studios, galvano baths and presses, shaving machines and buffing machines—every item for making disks. With a most complete plant and equipment, with a musical library as fine as any anywhere, with experts along every step of the way from business men and executives, through musical directors, talent, technicians, and workers, we felt ready to proceed.

We formulated ideals and we have stuck to them, without trying to discredit other firms or individuals who are doing a good job. We will rent our studios and equipment and the services of our technicians for recording programs not prepared by us. But we insist that they be of high quality, for we cannot afford to have poor programs recorded in our plant. Nor do we allow the release of programs prepared and recorded by us to stations not properly equipped to broadcast them. The results of these ideals, equipment, and personnel have been the recognition on the part of sponsors and stations that recorded programs have a definite place in the radio field if done properly, and the building of a clientele of the foremost sponsors.

RECENTLY, the Western Electric Company, having developed recording and broadcasting apparatus to a point hitherto unreached, equipped a number of broadcasting stations for operation from disk recordings. Others are being equipped every day. Looking about for a recording company whose work and personnel merited the installation of recording apparatus, Sound Studios of New York was chosen as the recipient of the first Western Electric license for the recording of broadcast programs. An entirely new set of equipment is now being installed in our studios, covering every feature of recording.

Recording broadcast programs involves a combination of artistry and engineering. The artistry lies in the preparation of the program, which should reflect the character, mood, tempo, and atmosphere of the sponsor and his product, appeal to the audience whom he wishes to address, and please that audience, making the listener desire to purchase the sponsored product.

The program having been prepared, the musicians and vocalists rehearsed, and the program given over the network, let us suppose that the sponsor wishes to get the full benefit of this fine program. He desires to use it for "spot" broadcasting from independent stations.

The recording studio is prepared. This room looks very much like any fine broadcasting studio, with soundproof walls and ceiling, ventilator to keep the room at constant temperature, control room looking upon the studio through a glass window in the wall, microphones, and so forth. In addition, there are the turntables, both for the small 10- or 12-inch records which revolve at 78 revolutions per minute and play about $4^1/_2$ minutes, and for the large 16-inch disks which revolve at $33^1/_3$ revolutions per minute and play for 10 minutes.

These turntables are powered by synchronous motors, which maintain a constant speed in spite of voltage fluctuations or other factors. The turntables are equipped with faders, by means of which one turntable may be faded off and another faded on, causing no break in the performance when it is desired to play two disks without interruption.

LET us suppose that a program is to be recorded on a 16-inch disk. Disks for broadcast recording, by the way, play from the center toward the rim, the reverse order of the usual commercial records. They are of the lateral cut type, the grooves being of constant depth and the stylus cutting the walls of the grooves; as contrasted to the "hill and dale" type, the name of which describes its principle. The wax which is really made of soap material—is placed on the turntable, the motor set and the microphones properly placed in the recording studio. Then the program is begun. The man in the control room lowers or raises the volume of each microphone independently. So it is that the soloist is heard above the orchestra even though in the recording studio she cannot be heard above the roar of the drums and the horns as she barely whispers into the microphone which is before her. Sometimes as many as four "mikes" are used at once.

The performance over, the wax, now referred to as having been "cut," is placed in the galvano bath. Swishing back and forth on the end of a long rod in the bath, the cut side of the wax is electroplated, after which the resultant copper "master" is stripped off. This, of course, is a negative of the wax, its marks being raised above the surface whereas in the wax they were indented. The "master" is then taken to the pressing room where two test pressings are made from it. The test pressings are composed of a combination earth-shellac material, identical with the material of the final pressings. This substance is heated, then placed in the press with the "master" and, under enormous pressure and heat, baked. The test pressings are then played for the approval of all the parties concerned. The musical director looks for faults, the sponsor listens closely, the technicians try to find something amiss. If everything is perfect, performance and recording, the technicians, musical director, and sponsor O.K. the pressing. Perchance a certain selection was not as good as it might be. It is performed over again and recorded. Then the first record is played again and recorded on a clean wax, the re-recorded selection being "dubbed" in at the proper time, in much the manner as a movie strip is inserted in the final film. Another "master" is made, and test pressings approved.

Were the final disks pressed from the "master," there would be no impression of the performance should the "master" be injured in the pressing, for the wax has already been shaved for future use. So the "master" is in turn electroplated and the resultant "mother" taken from it. The "master" is then filed away for safe keeping or use for subsequent orders for more pressings of that performance. But the "mother" has its lines indented. It cannot be used to press the final disks. So it too is plated and the "stamper" coming therefrom used to make the final pressings, which are then ready for the broadcasting stations, where they are transmitted by the use of apparatus similar to that on which they were recorded. In this manner is a radio broadcast program recorded.

Left: Adjusting one of the rods which move the waxes in the plating baths. **Center:** Examining a copper "master." **Right:** A wax ready for plating

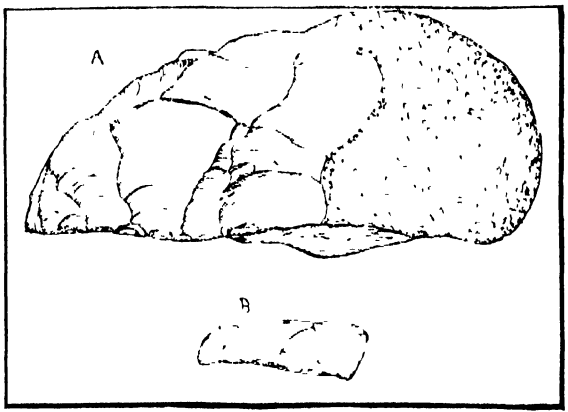
Making test pressings. The earth-shellac compound is being heated at the right to the consistency of dough. **Left:** One of the disk-baking presses

The uses of the recorded program are many and varied. It enables the independent station far from sources of entertainment talent to broadcast programs equal in quality to the finest network offerings, thereby enhancing its reputation and increasing its value to the sponsor. It enables the sponsor to reach his country-wide audience at the same hour despite time differences between the east and the west. It permits the use of radio by sponsors unable to book time on the networks; and for those already using the chain, makes possible the fullest use of their fine network programs. The cost of recording being divided between all the performances given by the disks, the individual programs are low in price, without loss of quality. The recorded program permits of editing, taking the finest portions of several performances, whereas in the direct program any slip passes directly to the audience and cannot be recalled.

FLINT IMPLEMENTS
Great and Small

By J. REID MOIR

As we all know, certain kinds of reptiles of the remote geologic past started their careers when they were of very small size and finished their earthly course when they had developed to gigantic and preposterous dimensions. In fact, so unwieldly and immense did some of them become that it has been supposed their disappearance was due to their great increase in size which made it impossible for them to adapt themselves to their environment. Whether, however, this theory is correct or otherwise, it is of considerable interest and, strange to say, has some kind of bearing upon certain problems which students of early man find themselves called upon to solve.



Drawings by the author

Figure 1: ***A* is a massive rostro-carinate from beneath the very ancient Red Crag of Suffolk. *B* is a diminutive rostro-carinate from the much later, second interglacial age in Suffolk**

THANKS to the researches which in recent years have been carried out in deposits containing the earliest flint implements, it is possible, and of much importance, to trace what may perhaps be termed the career of any particular type of artifact from its first appearance until it passed out of use. When this is done it is realized that in most cases flint implements, unlike ancient reptiles, first appear of a very large size, and dwindle finally to minute, and as it would seem, to almost useless proportions. It must of course be clearly understood that the earliest examples of any particular type of flint implement are not all of great size. But although this is the case, it remains true that the majority of these examples are of massive porportions.

The reasons for this largeness are by no means easy of explanation. It is probable that the size of the raw material played an important part in the dimensions of the resulting implements, but this reason must not be over-stressed. For, although it would not be possible to make large implements from small nodules of flint, it would be quite easy to manufacture small artifacts from masses of flint, however big. Again it may be imagined that the earliest men were of great muscular strength, possessing hands much larger than those of their descendants, and this may be regarded as a probable explanation of our problem, as certain very ancient flint implements which have been found are provided with what appear to be carefully prepared hand grips which were evidently not meant for hands of the span of those of today.

Whatever may have been the cause, a survey of the flint implements made by prehistoric man will show that, generally speaking, the more ancient these specimens are, the bigger will be their size. There is a difference of the same order to be observed in the flaking as, in the older implements, the flake-scars are large and caused evidently by powerful blows, and this peculiarity becomes progressively less marked as the specimens of later cultures are examined. It must not, however, be imagined that the fact of an implement being coarsely flaked points to a lack of knowledge of flint flaking on the part of its maker. In fact, in my experiments I have actually found it more difficult to produce say, a hand axe, solely by the removal of large flakes than by the detachment of smaller ones. It is, of course, true that the later implements exhibit a more delicate outline, or form, than the earlier, but this does not in every case mean that the former are more skilfully made than the latter. For instance, it would not be correct to claim that a Mousterian *racloir* exhibits more skill in flint flaking than does an early Chellean hand axe, and of the two types I would regard the Mousterian specimen as being much more easily produced.

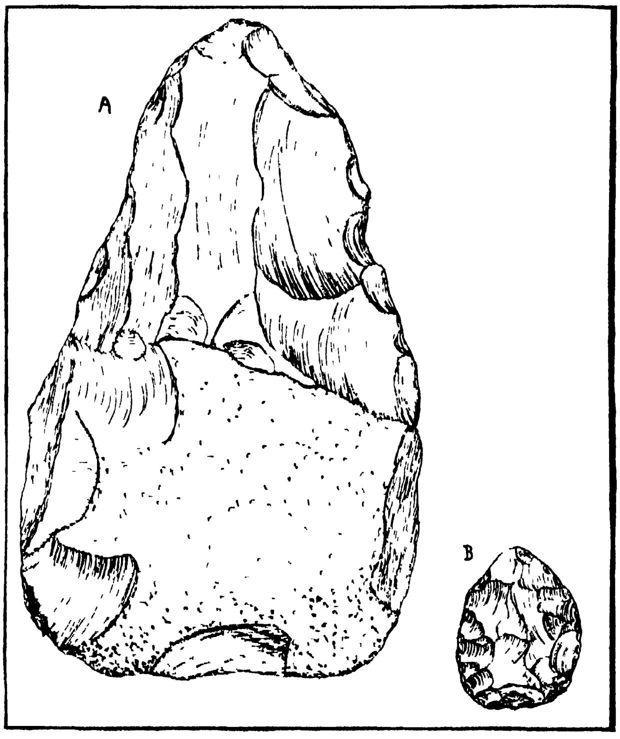


Figure 2: **Another contrast. *A* is a huge seven-pound hand axe and *B* is a diminutive hand axe**

ALTHOUGH up to a point it is legitimate to compare the invention, age, long use, and gradual discarding of any particular type of flint implement with the appearance, existence, and final disappearance of some form of life, yet I know of no particular form of artifact which, like certain animals, became actually extinct, and left no descendants. Even in Neolithic times the most primordial types of implements, the eoliths and rostro-carinates, appear occasionally; and other forms, clearly related to earlier artifacts, occur at that epoch. Neither is it possible to hold that such and such an implement appears first at a certain period and, as it were, to claim a "special creation" for it at that time; for a careful collecting and examination of the flaked flints of earlier epochs, will usually reveal forms clearly ancestral to that under discussion. As an example of this, mention may be made of the *tranchet* axe found particularly in the shell mounds of Denmark which are of early Neolithic Age. It is not long since this type of implement was regarded as making its first appearance at this epoch but recent researches have shown it to occur in the lower Paleolithic cultures of South Africa, at the lower level at Le Moustier in France, while I have found an example in a "floor" of early Mousterian Age in Suffolk.

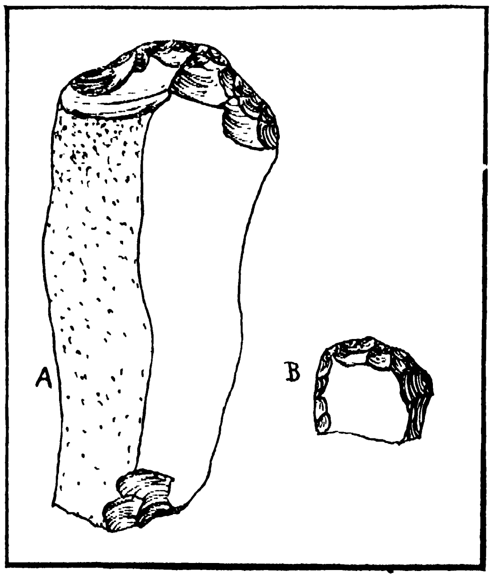


***Figure 3:* Contrast *A*, a seven-inch Mousterian (Neandertal) scraper, with *B* of Bronze Age from burial in Suffolk**

It becomes clear, therefore, that modern work in archeology is demonstrating that no prehistoric culture can be regarded as in a "water-tight" compartment, but each is indissolubly related to that which goes before and to that which comes after. But at certain epochs particular types of implements made occasionally in earlier times, suddenly, for some unknown reason, sprang into favor and these types became the dominating artifacts of those epochs.

THE problem of the implement of minute size is by no means easily solved. In Figure 1 are shown two rostro-carinate specimens, the larger found beneath the very ancient Red Crag of Suffolk, and of several pounds in weight, while the smaller, found in beds of second inter-glacial age near Ipswich, is a true rostro-carinate but of very small size. There is no difficulty in realizing the uses, such as chopping and picking, to which the larger of these two specimens could be put, but to what useful purpose can the smaller be referred? Again, in Figure 2, a huge hand-axe from the Cromer Forest Bed of Norfolk is illustrated beside a very small example of the same type of implement found in a floor of Upper Paleolithic age at Ipswich, Suffolk. Here the same difficulty of assigning a use for the smaller artifact arises, as it does also in the case of the scrapers (Figure 3) and *tranchet* axes (Figure 4).

I have sometimes wondered whether these very small implements of certain types were ever made for any utilitarian purpose but represent, rather, "models" of artifacts, the forms of which had been handed down by tradition. We know that in the Bronze Age flint scrapers, for example, were occasionally scattered over the burial sites of that period, thus showing that these specimens had acquired some magical value. It seems possible, therefore, that in the Stone Age some ancient types of implements were made also for the same occult reason and this may explain the minute artifacts to which attention is drawn in this article.

But while this may be the case, such an explanation can not apply to the widespread "pigmy" culture which marks the closing phases of the Stone Age. At this epoch, from the Vindhya Hills in India right across to western Europe and Britain, a remarkable flint industry is found in which many of the implements are literally of microscopic size. Some of them are as small as a grain of rice and exhibit edge flaking which is so minute that a strong lens has to be used in order to see it satisfactorily.

THERE is, of course, no doubt that these specimens are the work of man but it is also evident that their makers must have been possessed of eyesight much keener than the average person of today, who, with unaided vision could not flake flints in such a manner. Some of the specimens assume geometrical forms and are believed to have been inserted in pieces of wood as harpoon barbs. But this explanation does not cover all the types of pigmy flints, and the uses to which many of them were put remain obscure.

Associated with these very small artifacts and obviously of the same age are numerous implements of much larger size, thus showing that the smaller were made for some specific purpose. The notion was at one time put forward that these microscopic implements were made by a race of very small people, of about three feet in height. But this view was soon demolished by some one who pointed out that if a flaked flint one eighth of an inch in length pointed to its maker standing only three feet, then by the same reasoning a specimen 10 inches long must have been produced by a super giant. When, as in very ancient specimens, definite hand grips are found to have been produced upon implements, it is possible to come to a conclusion as to the size of the hands of those days, but to judge of the height of past races of mankind by the length of the implements they made is patently absurd, for this would connote the previous existence of numerous races of true story-book giants, and we are sure there were none.

The fact of the matter is that our knowledge of the uses to which many stone implements were put is almost negligible. We have at present reached the stage when it is possible to claim on scientific grounds that certain examples exhibiting flaking have been shaped by man. Further, we can with equal certitude state that these specimens were weapons, implements of one kind or another.

BUT it is not possible for us, and it may never be, to assert that these artifacts were put to this or that particular use. It is clear, however, that the great majority of the humanly-flaked flints which are discovered are merely tools with which other things of wood, ivory, and bone were made. But, except in a very few cases where conditions have been favorable to the preservation of such specimens, they have failed to survive the vicissitudes of the past. This fact should always be kept in mind when attempting to reach a conclusion as to the state of culture existing among any prehistoric people, as the flint implements they made are only the indestructible residue of their industry, and to judge of their condition of advancement merely by taking into account this residue, must clearly be entirely misleading.

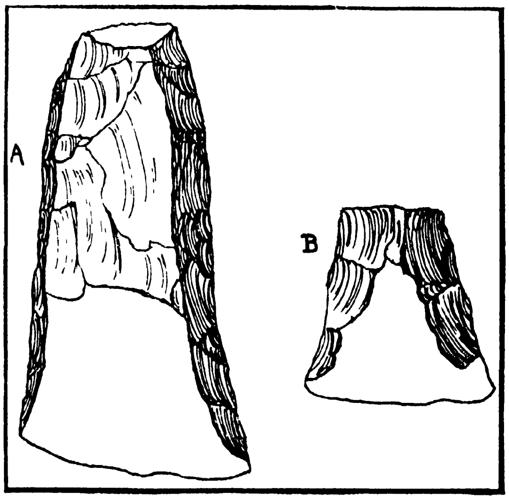
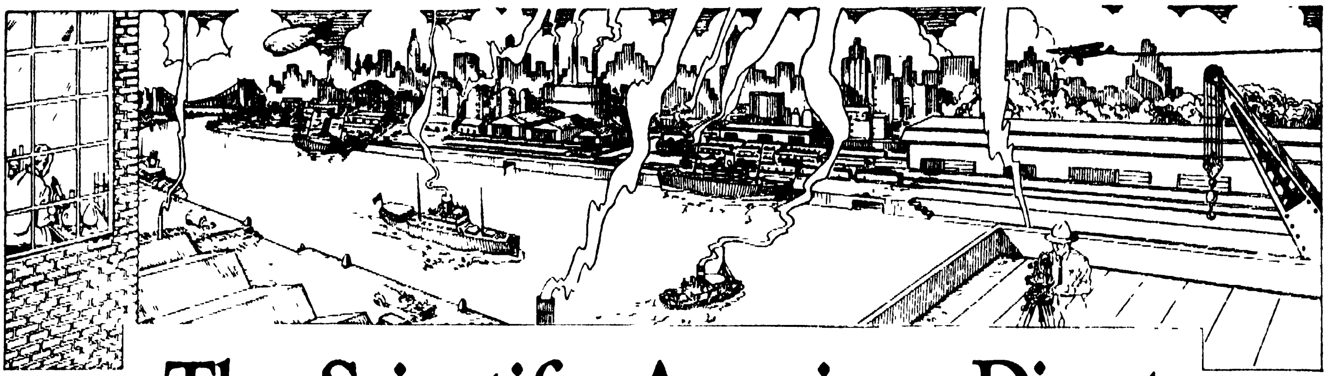


***Figure 4:* *Tranchet* axes great and small. *A* is from Paleolithic deposits in South Africa and *B* is from much more recent beds near Ipswich, Suffolk**



The Scientific American Digest

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Index Globe for Study of Geography

THE self-pronouncing dictionary now has a rival in geography in the form of a unique globe which was shown at the American Library Association conference in Los Angeles recently. The globe was invented by Charles M. Williams, a resident of Los Angeles for 40 years.

By means of paper rolls inside the globe, the location of more than 43,000 towns, mountains, rivers, and bays is indicated automatically through a small window when a handle at the bottom of the globe is turned. When the location is noted from the inner index, the globe may be turned, and the place found immediately by means of a special finder scale. If the globe is turned farther, a description of the country, a list of its products, its climate, and photographs of scenes in the country may be seen through a second small window on the side opposite the first. This globe also shows the point in the world where any constellation of stars will be visible at a specific time, and the point on the earth where, on any particular date, the sun will be directly overhead.

Courtesy Los Angeles Herald

As the handle is turned, the index gives the information desired

Hudson River Bridge Cables Completed

THE spinning of the last wire for the last cable of the Hudson River Bridge at New York, took place shortly before noon on August 7, thus marking the completion of a major and probably the most spectacular phase of the building of the structure The occasion was informally observed at the Jersey end of the span. Commissioners of the Port of New York Authority, which is constructing the bridge, and a number of other interested persons assembled on the Palisades as the last wire, to which was attached a small American flag, came across the river from the Manhattan side.

The spinning of the four enormous cables was completed in less than 10 months, the first permanent cable wire having been strung on Friday, October 18, 1929. The number of men engaged in the spinning operation was approximately 400. One man was killed at the New York anchorage while setting up spinning equipment, but none was seriously injured or killed during the spinning operation. Only about 27 days were lost due to inclement weather conditions.

Complete details of the cables and the methods of spinning were given in an article in the January, 1930, issue of SCIENTIFIC AMERICAN.

Illegal Guns Slaughter Waterfowl

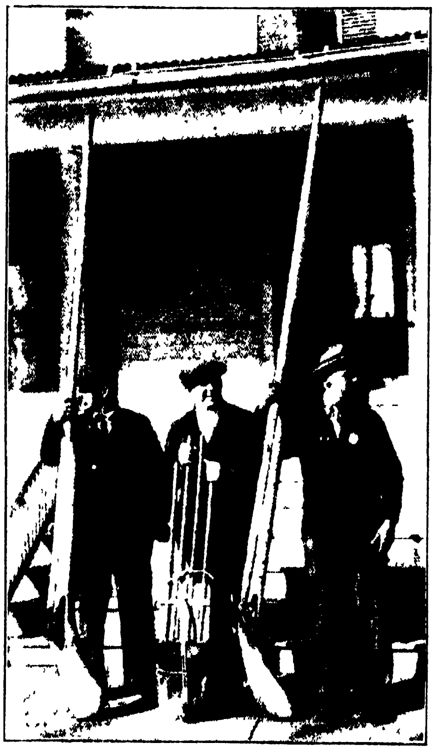
DESPITE the fact that both federal and state laws prohibit the use of guns larger than 10-gage in taking waterfowl, game wardens from time to time discover elaborately built "artillery" used for this purpose. Every person, whether he be a sportsman or not, should assist the authorities in wiping out this illegal method of hunting and use every effort to assist in securing conviction of the violators.

In the accompanying photograph are shown three illegal guns captured by game wardens in Maryland. The one in the center was captured last January by Aleck Tyler on Fox Island, which lies along the Maryland-Virginia boundary line. It consists of four barrels, each of a different length and having muzzles one inch in diameter, all bound to a large oak block by means of an iron band. The total weight is 125 pounds. Carved in the wood at the base of the barrels is a groove for powder which is ignited by means of a percussion cap fired by a hammer on the right hand barrel. This arrangement causes firing of the four barrels in rapid succession.

The two long guns, one eight feet and one nine feet long, and weighing 90 and 100 pounds respectively, were confiscated by Warden Tyler, together with two Deputy Wardens and Orin D. Steele, United States Deputy Game Protector. These guns are made of two-inch galvanized piping with one end brazed to form a chamber, mounted on home-made stocks. The charge for one of these guns consists of about one fourth of a pound of powder and one pound of shot.

Such guns are used by violators of wild fowl laws for hunting wild fowl at night. The large single barrel guns are usually locked to a skiff, the barrel projecting over the bow and the breech supported by some object at the butt and fastened in such a manner as to take up the recoil. The battery type is usually mounted on a swivel. These guns are very destructive and will kill at one firing from 100 to 150 birds and cripple many more.

The hunter who follows this method of



Deadly guns for slaughtering waterfowl, confiscated in Maryland

shooting wild fowl is very hard to apprehend since he uses a small skiff with a short paddle, sneaking at night into large rafts of waterfowl on their feeding grounds. Since the water is shoal on these grounds, it is very easy for the pot-hunter to get within range of the birds before they become suspicious.

Entoptical Effects—Can You See Them?

MR. L. F. CULVER of Gautier, Mississippi, one of our readers, sends us the following note concerning a peculiar effect in the realm of physiological optics. He describes phenomena which other readers may be able to duplicate.

"Many times," Mr. Culver writes, "while lying on the ground with a straw hat over my face I noted that for each tiny opening through which light came I saw a round light spot about one fourth inch in diameter and with a dark center. At length I saw that these light spots were all of the same size, and I also observed that the dark centers were of irregular form, but all exactly alike in detail, except that the spot seen by one eye was totally different in form and detail from that seen by the other eye.

"Then I noticed on successive days that these dark spots always looked exactly as at first. As their form was not at all dependent on the form of the openings in the hat through which the light came, I concluded that what I was seeing was within the eye itself and must be the blind spots on the retina, that I had learned of in my school days.

"I tried other ways of seeing them and discovered much that was unexpected and very interesting and beautiful. This, I found, required considerable patience and perseverance, but the reward was ample. I think it best, however, first to try the method described above.

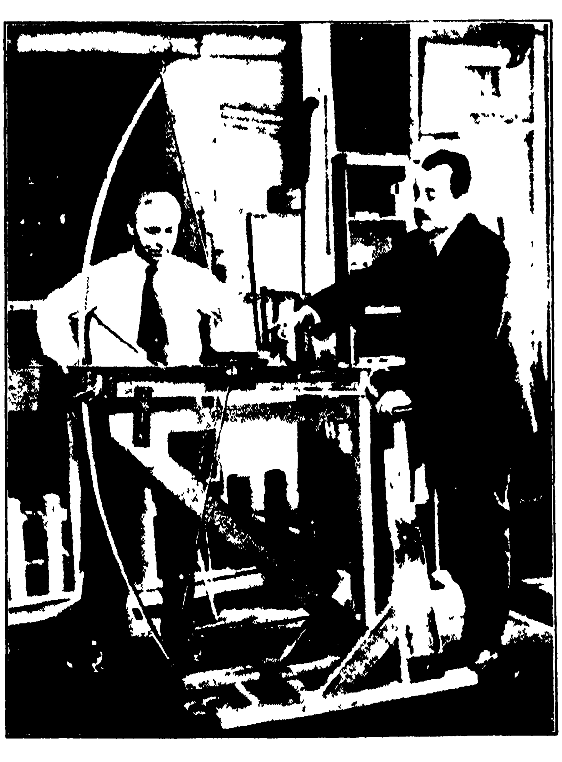
"At night sit with the side of the head toward the source of light and facing a darkened part of the room or a door opening into a dark room. Hold about one inch from the eye farthest from the light some small, polished, spherical surface of one-eighth inch or less in diameter to reflect the light into the eye. This illuminates a part of the retina. Near the center of the illuminated part will be seen the blind spot. The dark nucleus of the spot evidently is bordered by a row of highly sensitive nerve filaments which appear like a row of brilliant bright dots close together. In my left eye there are three small blind spots outside of the main spot. The borders of these also are studded with bright points. The group reminds one of a group of sun spots seen through a telescope. Under stronger illumination, as with direct sunlight, bright points appear, sparsely scattered over the entire blind area, and much new detail is seen. Whatever the reflecting surface used, these spots change their form. The amount of detail seen varies greatly with the degree of illumination."

These phenomena are known as "entoptical" effects and are described in works on physiological optics, most comprehensive of which is the famous "Treatise on Physiological Optics" by the great German authority Helmholtz. This three-volume work of 1700 pages is an old standby to all physicists and opticians. Recently it has been translated, and thus made easily available to English speaking readers, by Professor James P. C. Southall of the Department of Physics at Columbia University, author of "Mirrors, Prisms and Lenses," himself an authority on optics.

"Under suitable conditions," says Helmholtz, "light falling on the eye may render visible certain objects within the eye itself. These perceptions are called entoptical. . . . There are some objects in the eye, particularly the blood vessels of the retina, which fulfill the latter condition by being very close to the sensitive membrane and therefore in position to cast shadows on the retina." Fully to describe these and a wider variety of entoptical effects would, however, demand as much space as is devoted to them in Helmholtz' treatise.

While Mr. Culver's discovery is not new to science, he made it independently. When his note, as reproduced above, was submitted to Professor Southall for opinion, the latter commented, "I think Mr. Culver deserves much credit for having made these experiments for himself."

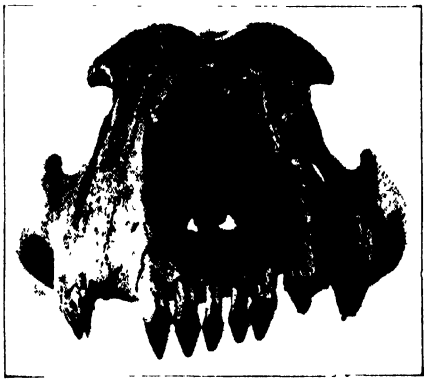
Perhaps others of our readers can duplicate these effects.



As the age-old sport of archery takes a new hold on the interest of thousands, problems of constructing bows and arrows have had to be solved anew. Much success has attended the efforts of the manufacturers, but there is still much to learn. The illustration shows a new machine displayed some time ago by the archery club of Seattle, Washington, for testing the accuracy of arrows. With this home-made contraption, arrows can be tested so that their feathers may be trimmed, thus making possible the shooting of an entire quiver of arrows under any given set of conditions

When the Tiger Lost a Saber

IT is said that Mrs Paleolith would quiet her young Paleoliths by saying she would call Old Saber-Tooth; and these giant long-toothed cats were indeed fearful-looking creatures. Once in a while saber-tooth skulls from which a saber 10 inches long had been lost, are seen, but the animal had survived the loss bravely It is thought that these toothed cats used the long sabers for stabbing the prey in order to drink the blood, but it was possible, when a saber was lost, to survive by eating flesh. This particular tiger lost the saber when young, the saber-tooth being broken off far up in the socket. Its loss produced a curious asymmetry due to the necessity of filling in the large socket. In loosing a saber the great cat had had its face lifted. The front teeth in the tiger's left jaw are elevated and the bones reduced



When this tiger lost one of its saber teeth at an early age, its jaw grew asymmetrical, one-sided

Chemistry and the Old Rag Man

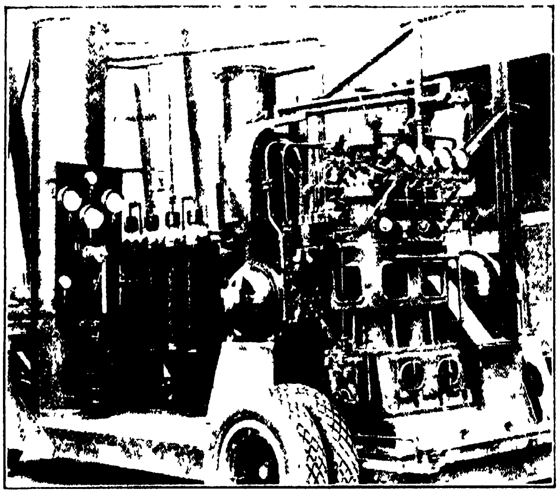
RAYON has given us wonderful and beautiful varieties of cloth but, when the glossy fabric has served its purpose and found its way into the rag bag, it is not popular with the rag man. Before the advent of rayon, "old rags" were the raw material for the finest grades of writing paper. Recent tests by the United States Bureau of Standards disclose the fact that rayon rags are valueless for this purpose, and may actually be detrimental. Laboratory tests were conducted at the bureau to determine the paper-making quality of rayon when subjected to the same treatment as rags in the production of fine papers.

Cotton and linen fibers are commonly used for papers, such as bonds and ledgers, on account of their strength and durability. In addition to their value in these respects they are used in the manufacture of papeteries and other fine writing papers, as well as to impart softness and other desirable characteristics of surface and finish. The presence in rag stock of any fiber which would affect these qualities of paper is undesirable.

Samples representative of the four general processes of rayon manufacture—viscose, nitrocellulose, cuprammonium, and cellulose acetate—were included in the tests. The equipment employed in the preparation of the pulp and its subsequent conversion into paper was on a laboratory scale and is that used at the bureau for the preliminary tests of all paper-making materials under investigation. The caustic soda and lime processes were used in the cooking operation. Paper-making stock was prepared from the pulp, alone and in admixture with sulfite pulp, and converted into paper on a sheet mold.

Owing to loss of strength when wetted, the rayon filaments tended to break into short lengths during the preparation of the paper-making stock without the fibrillation and fraying necessary for good felting properties. As a consequence, the all-rayon sheets lacked the strength to withstand the handling necessary in the pressing and drying operations, and the pliability characteristic of rag papers. Likewise, sheets made of rayon in admixture with sulfite pulp were considerably weaker than those made from sulfite alone.

Since increasing amounts of rayon are being found in the rags and textile waste used in rag-paper manufacture the test data are believed to be of value to that industry.



When helium becomes diffused with ordinary air a condition that might take place in a dirigible due to leakage of the gas envelope—its "lift" is decreased in proportion to the adulteration. Because of this fact, the mobile helium re-purifier shown here was built for the Goodyear-Zeppelin Corporation. It removes air and any other diffused gas from helium by the process of freezing out, as explained in the text

A Chemical Service Station for Dirigibles

In a few years, when air travel is as commonplace as railroad travel today, machines like that pictured here may become as familiar to travelers as the workman who taps the axles while the train is standing in the station. This trailer full of motors and compressors will draw up alongside your dirigible and will start to work, drawing the helium gas out of the balloonet, removing the air that has mixed with it, and returning it to the ship with its full lifting power restored.

The mobile helium re-purification plant was built for the Goodyear-Zeppelin Corporation, of Akron, Ohio, by the Helium Company of Louisville, Kentucky. The entire plant, with a capacity of 1500 cubic feet of gas per hour, is mounted on a pneumatic-tired trailer body and can traverse any terrain which a truck can negotiate.

The mobile plant consists essentially of two compressors, one handling air, the other helium. The air compressor supplies air at high pressure to an expansion column, which serves to liquefy a portion of the air, forming a cooling bath at a temperature of —170 degrees, Centigrade. The second compressor forces helium at 2000 pounds pressure through copper coils immersed in this liquid air, with consequent removal of impurities by liquefaction. The helium passes through nearly a half-mile of copper tubing, and is finally discharged at a purity of 98 to 99 percent to any desired point and at any pressure up to 2000 pounds per square inch. The loss in re-purification is approximately 1 percent.

The mobile helium repurification plant was designed by R. R. Bottoms, director of research, and E. G. Luening, executive vice-president of the Girdler Corporation, which operates the Helium Company. These men were also responsible for the development of the special fuel gas used by the Graf Zeppelin on its first return trip to Friedrichshafen from the United States. —*A. E. B.*

"Jake" Paralysis

During the past few months thousands of cases of paralysis from drinking bootleg Jamaica ginger have occurred, principally in the southwestern portion of the United States. Studies made by chemists indicate that the poisonous substance is a derivative of coal tar or phenol. Few of the patients have died, but practically all of them have developed forms of paralysis which seem to be fairly permanent. The nerves affected include those of both the arms and legs. The nerves conveying sense of pain, touch, and heat have not usually been disturbed, but in some cases the patients seems to lack also these sensations. In one instance in Oklahoma City a traveling man 66 years of age died following paralysis from drinking Jamaica ginger. Postmortem examination indicated that in some manner the poison had selected the nerve of motion in the arms and legs. The tissues of the brain were not apparently greatly influenced by the poison. Post mortem examination also revealed that death was apparently due to a previous kidney disease, complicated by his secondary illness, rather than to the Jamaica ginger.—*M. F.*

Ancient Bacteria Preserved in Fossil Bone

It has been a matter of surprise that such minute, delicate bits of protoplasm as bacteria should be found in thin sections of bone many thousands of years old. Yet in the bone of an ancient tiger, under the microscope, are found undoubted germs resembling some of the bacteria of today. The picture shows, at a magnification of 100 diameters, colonies of bacteria in the minute, thread-like canals leading out from the bone cells which appear in the picture as dark diamond-shaped bodies. It is not known whether or not these ancient germs brought on disease but it seems likely that they were the germs of decay.

Peculiar Aviation Inventions

We are constantly receiving suggestions for peculiar types of aircraft and aviation accessories, some provocative of thought, some merely of amusement. The inventors, however, are in dead earnest, and full of the desire to advance aviation. Here are extracts from an anonymous letter, with the envelope bearing a Canadian postmark. "Dear Sir. I am quite unknown to you and you are to me. However I do not hesitate to address you this letter, for if the idea that it contains is good it matters little to know whence it comes but it matters only to use it. So I desire to remain unknown but I desire also an experiment to be done, that, in my opinion will give the best results . The motor of the plane works in the air by means of the propeller. But the propeller with two blades is an instrument with which the motor can work but little in the air in one turn however let us consider that to the two blades of the propeller, one can add 16 other blades on the same circumference That makes a propeller with 18 blades; it is the American Wheel. To be used for speed it is necessary for a motor to make much work during a turn "

The suggestion is a typical one. Such inventions always come down to a question of arithmetic. It seems at first sight plausible that with only two propeller blades on a shaft, the intervening air is not worked upon properly. But when the suggestion is examined technically, it is found that two propeller blades already take up the entire power of the engine, and that the efficiency of the two-bladed propeller in producing thrust may be as high as 85 percent and as nearly the theoretical values attainable as will ever be practicable. When a multiplicity of blades is used, the interference between them is such that the efficiency is greatly reduced instead of being improved.

Fossil bacteria in fossil bone

In almost all the suggestions received, the same question of arithmetic is neglected. Dozens of plausible helicopters are suggested, with some screws for lifting, some for propulsion, and so on. There is nothing theoretically wrong in such helicopters, but when the invention is examined it is found that the inefficiency of the various elements, the complication of the mechanism, and failure to consider certain factors of stability and control make the idea quite impracticable. There appears to be in the United States an inexhaustible fund of inventiveness and courage. The prime necessity is to add to mechanical instinct at least a modicum of analysis with reference to air forces and efficiency. At the same time, one dare not predict that some instinctive mechanic will not yet contribute to our knowledge without such basic analysis!—*A. K.*

A Chemical Paradox

NOTABLE among the triumphs of industrial chemistry during the past decade has been the development of commercial processes for the synthetic manufacture of ammonia and nitric acid. Because of the efficiency of these new methods, ammonia is being sold at prices which make it attractive in many new industrial roles, some of which were described in an outstanding paper presented by Jasper E. Crane, of the duPont company, at a recent meeting of the Manufacturing Chemists' Association.

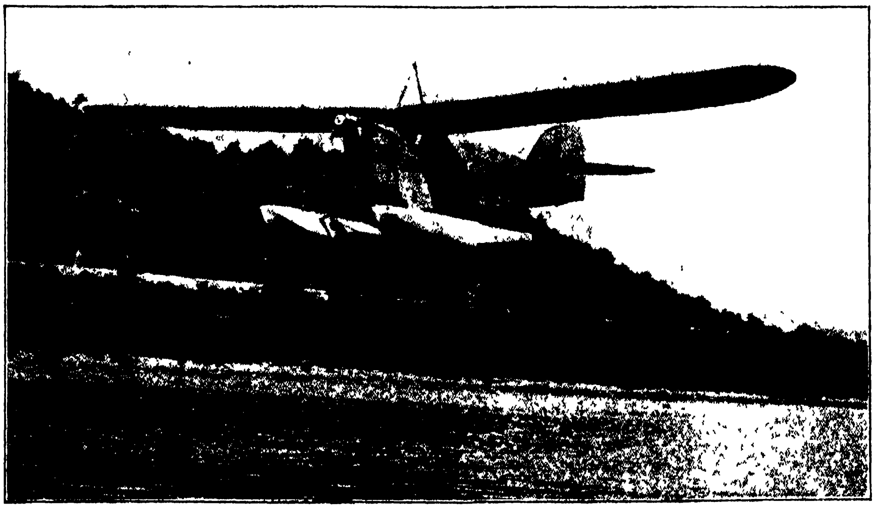
Among the most attractive of the newer uses for ammonia is its application as a source of hydrogen, particularly for welding. It seems, offhand, to be paradoxical to state that it is economical to combine hydrogen with nitrogen to form ammonia, then to separate the two gases again in order to obtain the hydrogen. The answer to the paradox lies in the fact that one cylinder of ammonia, when "cracked" is equivalent to about 17 cylinders of hydrogen. As the principal part of the cost to the user of hydrogen is the cost of the cylinder, he finds that he saves about one-half by buying 17 times the volume of hydrogen in a single cylinder. Simple, inexpensive apparatus has been developed for cracking the gas by use of an electrically heated catalyst.

An even more striking reduction in cost is that of nitrogen made by the cracking process. The cracked gases are burned in air, producing water and nitrogen. One cylinder of ammonia, in this case, is equivalent to about 36 cylinders of nitrogen at one ninth the cost.

Other better-known uses, of course, are much more important as tonnage markets for ammonia. These include the production of synthetic organic chemicals in great variety; nitric acid and synthetic sodium nitrate; fertilizers; nitrided metal products; and its uses as a cheap alkali. —*A. E. B.*

An Interesting Light Plane

THE popular interest in gliders has been followed by enthusiasm for the light plane. One of the most successful of these small planes, with success measured not only by flying ability, but by large sales also, is the *Aeronca* built by the Aeronautical Corporation of America. This plane is equipped with a relatively small engine of the two-cylinder opposed type, 4⅛-inch bore and 4-inch stroke, rated at 30 horsepower at 2500 revolutions per minute. The weight empty is 385 pounds, the disposable load (with one occupant) 315 pounds, thus the total or gross weight is only 700 pounds. The span is 36 feet and the wing area 144 square feet. The top speed is given as 85 miles per hour, the landing speed as 31 miles per hour, and the initial climb as 550 feet per minute. Such performance is quite adequate for private flying, except for cross-country work under adverse wind conditions.

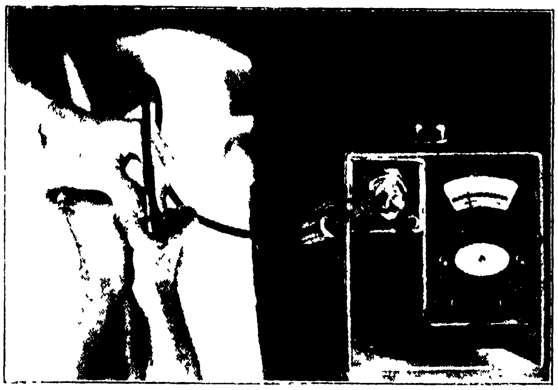


Quite adequate for private flying, this plane, empty, weighs 385 pounds

The main interest of the *Aeronca* from a flying point of view is in the low wing loading, the use of relatively large control surfaces, and of large dihedral and vertical fin areas.

The low wing loading, 4.8 pounds per square foot of wing area, means low landing speed, quick getaway, and short pull up. This makes for safety and for the possibility of using small fields.

The large dihedral (raising of the wing tips relative to the center) makes for stability in a side slip. The large vertical tail surfaces give weather-cock stability, the plane swinging into a side wind instead of swinging dangerously away from it. The large control surfaces, on the other hand, make for ease of control in spite of the inherent stability. The aerodynamic conception, although not exactly novel, makes for ease in flying. Machines of equal stability and the reasons for such stability have been known since 1910 or thereabouts. But it is gratifying to see designers take perfect stability as their objective again. If there is to be private flying, machines must nearly fly themselves. There is but one serious disadvantage to such a lightly loaded plane: gusty weather is apt to result in difficulties near the ground and considerable bumpiness aloft.—*A. K.*



Most of us are familiar with the clinical thermometer but few, among laymen, realize the necessity for taking temperatures on the surface of the body. The illustration shows an improved electrothermal instrument for measuring body surface temperature and the text herewith explains the need for it

Body Temperature Measurement

THE measurement of the temperature of the human body on the surface and at various points represents one of the most important observations made by the physician in the diagnosis of disease. It has been recognized for years that infection produces congestion and fever. There is increased flow of blood to the part involved which is responsible for the changes that occur.

Investigators in the Mayo Clinic have recently developed an electrothermal instrument for measuring surface temperature and also for measuring temperatures of various organs at any given time. In case the temperature of an organ or of the spinal fluid or of the brain is to be determined, a needle is introduced and by means of the thermocouple method the temperature at the point of the needle can be ascertained. The sensitivity of the electrothermal junctions is increased by putting four couples in series; the galvanometer is calibrated in degrees Centigrade. Thus it is possible to measure the temperature at any point in the body in 10 seconds, absolutely accurately, and within a fraction of a degree.—*M. F.*

Lightning and the Airplane

WALTER E. BURTON, writing in *Aviation*, describes some interesting experiments now being conducted by the Ohio Insulator Company on the effects of lightning on the airplane.

In a thunderstorm, lightning is more feared, but wind is much more dangerous.

In the new chemistry classrooms at Princeton, the apparatus needed during a lecture is kept behind this blackboard which slides up like a window. Thus while the professor lectures, attention-distracting equipment is kept hidden from the students although it is set up ready for instant use when needed

Nevertheless the effects and dangers of lightning are well worth investigating.

The lightning laboratory of the Ohio Insulating Company is unique. With new equipment being installed, the laboratory will be capable of producing a spark at more than 3,000,000 volts pressure, nearly 30 feet long. In an open-air laboratory three transformers, the largest ever built, are used to produce the huge spark. The units are arranged in steps on a special porcelain tile base; the highest stands 50 feet above the ground. A number of oscillators are available to produce a continuous spark discharge. A camera with a shutter operating at 1/50th of a second is used for photographic studies of the flash.

At one end of the open air laboratory, a system of poles, guys, and insulators will allow the suspension of airplanes as large as a Ford tri-motor for experimental purposes. Because wind may blow discharges to one side, the airplane is in a field which is sheltered by groves of trees. So far experiments have been made only on airplane models. Later a full-size plane will be suspended with every part complete, the gasoline tanks full, and the engine running. It is not yet certain, however, whether the experiments with gas aboard and engine running will be possible without undue danger.

One problem has already been solved· a plane can be struck, can deflect a lightning discharge and become part of its path as it travels from cloud to cloud, or from cloud to ground. Among the many other problems to be investigated systematically are

If a plane is struck, what is the probable effect on pilot and passengers?

If a lightning discharge takes place near a plane without actually striking it, will the pilot receive so large a shock as to lose control temporarily?

How vulnerable is the ignition system?

Do the exhaust gases, because of their ionizing effects, create a path for, and attract the lightning?

What is the fire hazard for tanks, fabric covering, and so forth?

What happens when metal parts are not completely bonded? Will sudden currents of several hundred thousand amperes passing through imperfectly bonded joints fuse the metal parts instantaneously?

We shall await with great interest the results of the experiments.—A. K.

Germans Isolate Ethyl Radical

POLITICIANS have definite, though varying, ideas of what a "radical" is, but when the chemist refers to a "radical" he means something quite different. In chemical parlance, a radical is a certain definite combination of atoms which stick together persistently and act, chemically, as a single atom. Thus, the two elements sulfur and oxygen are prone to link together as the radical SO_4 and to retain the identity of their union in compounds such as sulfuric acid, (H_2SO_4), calcium sulfate, ($CaSO_4$), and so on.

Now these radicals have been assumed to exist for years, although no one has ever seen any SO_4—it doesn't exist alone. Neither had anyone ever seen the important radical C_2H_5 which is part of the molecule of ethyl alcohol, (C_2H_5OH), until recently. Now, however, two German chemists report that they have isolated the radical C_2H_5—an announcement which to a chemist is about as startling as saying that a soul has been separated from a man and put in a glass case for observation.

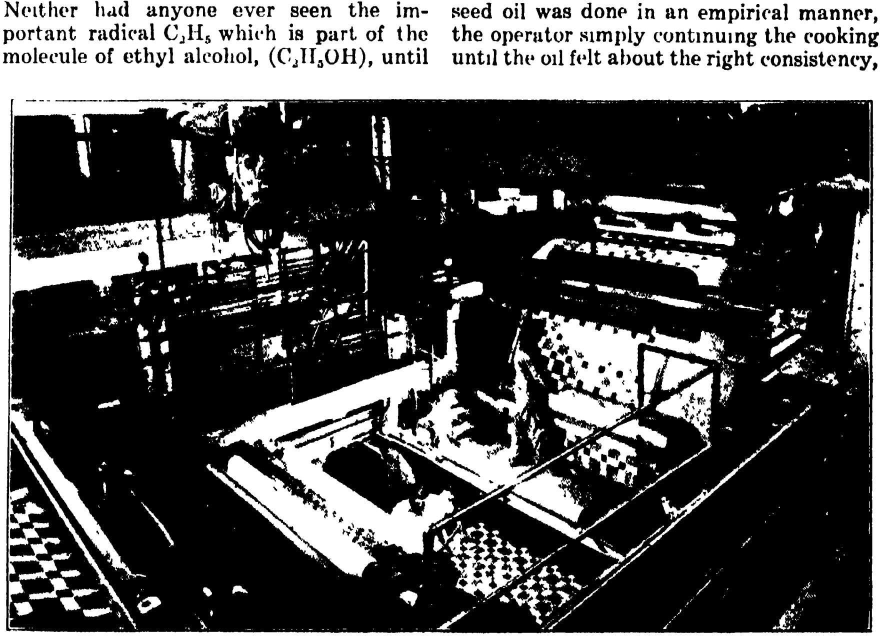
Professor Paneth and W. Lautsch have succeeded in producing the radical ethyl in a free form by the thermal decomposition of the vapors of lead tetraethyl in a current of hydrogen under diminished pressure. The ethyl radical is just as aggressive as the methyl recently isolated by Paneth and Hofeditz. Free ethyl converts such metals as lead, zinc, antimony, and cadmium into volatile compounds, which are clear as water at room temperature and 760 millimeters pressure. —*A. E. B.*

An Industry That Grew from a Paint-Pot

A PAINT pot, accidentally left uncovered, furnished the clue to several great industries that have grown up since Frederick Walton found his paint covered with the tough skin of dried oil. In his efforts to make something useful out of that film, Walton eventually laid the foundations for the linoleum business, for he discovered that the dried oil could be ground up, mixed with granulated cork, and made to adhere to a canvas or burlap foundation. The inventor died recently at the age of 94, having lived to see a giant industry arise from his early experiments.

Although modern linoleum is characterized by a beauty and durability undreamed of in the early days of its manufacture, the process of manufacture is fundamentally the same as described in Walton's original patents. Linseed oil, pressed from flaxseed, is boiled to the consistency of molasses so that it will oxidize or dry out quickly. This same boiling process is the beginning of patent leather manufacture and that brings us to the place where our chemist friend, Professor J. S. Long, of Lehigh University, comes into the story.

Several years ago, a certain manufacturer of patent leather asked Dr. Long to tell him why the patent leather surface of shoes cracked when the shoes were worn. Dr. Long found that the boiling of the linseed oil was done in an empirical manner, the operator simply continuing the cooking until the oil felt about the right consistency,



A giant rotary press used in making inlaid linoleum without the aid of human hands. The operators are inspecting the linoleum as it comes from the press

when rubbed between the fingers. The chemist, knowing the fallibility of human judgement, began to investigate the reason why linseed oil "thickens" on cooking. He soon confirmed his suspicion that the change was due to an increase in the molecular weight of the oil. From there it was easy to develop a simple method of determining the molecular weight of the oil as the "cook" progressed, and to stop at exactly the right point. Thus, perfect uniformity of product is obtained, and the patent leather manufacturer is no longer subject to the troubles that were his lot when he depended on the guess of his workmen. This piece of research work was the starting point for a series of investigations at Lehigh University that have almost as much significance for the users of linseed oil as Walton's curiosity about the film in the paint pot.

In the modern linoleum plant, the boiled linseed oil is run into a trough, from which it trickles down over sheets of scrim which hang from ceiling to floor of the oxidizing shed. The boiled oil oxidizes rapidly, forming the tough, elastic skin, which is ground up to a pulp and then mixed with rosin and other gums in large kettles. When the mixture cools, it is chopped up into convenient sized chunks and aged for several weeks before it is mixed with the finely ground cork. Color pigments are also added to the mix which is fed between huge steam heated rollers. The usual backing material is burlap. To obtain the many colorful designs which make printed linoleum such a popular floor covering, the plain material is run through massive printing presses, after which it is run into the "stoves" for drying and toughening. The more expensive grade, known as inlaid linoleum, is made by fitting vari-colored tiles of linoleum into a pleasing pattern, which is fused in position in hydraulic presses.—*A. E. B.*

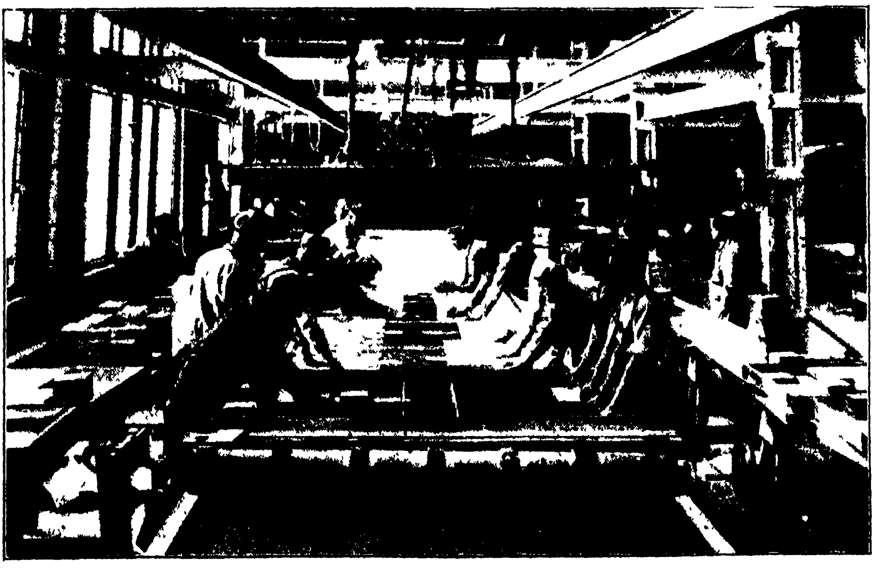
"Sunshine" Lamps

THE tremendous vogue of the use of lamps producing ultra-violet rays has caused considerable consternation among physicians who realize the limitation of these lamps for health and also the fact that there are all sorts of peculiar devices offered to the public, in many instances without any certainty that the device will actually produce good results or that it will provide the ultra-violet that the person wants. In order to bring some control into the field, the Council on Physical Therapy of the American Medical Association has issued a manifesto to manufacturers, defining the limitation of such apparatus and the claims with which it may be sold.

Because of the possible danger of lamps of high intensity, the Council has taken the stand that any "sunshine" lamp sold directly to the public should be so constructed that the radiant energy emitted shall not differ essentially from sunlight. In general, the Council believes that more conservative claims for the necessity of strong sunlight should be made by the manufacturers of lamps for home use, such statements being restricted to those which can be justified by conclusive scientific evidence. The Council is not convinced that human beings in good health require the great amount of ultra-violet energy which one is led to believe is the case from the advertising and descriptive matter pertaining to some of the so-called "sun-lamps" sold to the public.

A number of the more responsible manufacturers have fully agreed with the opinion of the Council. The emission characteristics of their lamps are in essential agreement with the requirements established by the Council, and in their advertisements they carefully avoid making curative claims. Furthermore, in these advertisements attention is called to the advisability of consulting one's physician before exposing oneself to ultra-violet radiation.—*M. F.*

Each roll of linoleum is inspected by experts but also is subjected to as many as 110 laboratory tests before it is ready for shipment



Duplex table method of making straight line inlaid linoleum. After pieces are laid as required by the pattern, they are fused together by hydraulic presses

One of the "stoves" in which printed linoleum is "festooned" for final toughening and aging

Reforestation in 1929

REFORESTATION in the United States last year restored to tree growth a total of 111,175 acres, the Forest Service of the United States Department of Agriculture reports. This included the planting of 31,430 acres by 21 states and two territories, 5920 acres by municipalities, 25,088 acres by industrial organizations, 539 acres by schools and colleges, and 1516 acres by other organizations Farmers planted 24,825 acres to wind-breaks and woodlots, and other individuals planted 3650 acres. The Forest Service planted 18,207 acres of land on national forests last year.

The First International Air Safety Congress

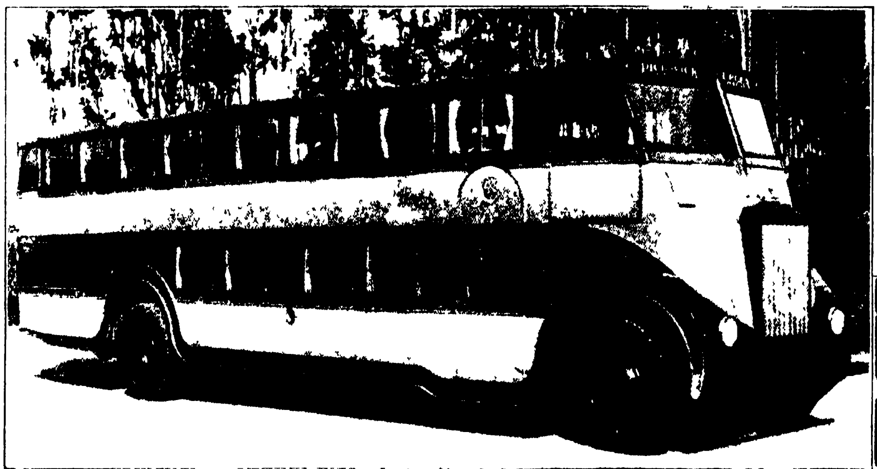
THE First International Congress for Safety in Aeronautics will be held in Paris during December, 1930. It is being organized by the *Comite Francais de Propagande Aeronautique*, under the presidency of the French Air Minister. Aircraft safety is not a matter of a single invention, but a question of improvement along innumerable lines. Nothing illustrates this fact as much as the program of the Congress, to which eminent authorities from every civilized country will be asked to contribute memoirs and investigations for consideration by the delegates

The Congress is divided into seven groups and six sections. Group A will deal with safety organization in various countries and with the statistics of accidents. Group B will cover the general problems of air safety, under the following six sections: Safety of Materials; Aerodynamic Safety; Engine Reliability; Aids to Navigation; Meteorology and Aerology; Navigational Instruments and Radio Communications. Group C will consider the application of the best safety methods to all branches of commercial aviation. Group D is concerned with the physiology of the pilot and other questions of a medical aspect. Group E is concerned with the training of flying and ground personnel. Group F will take up methods of protection such as parachutes, means of preventing or extinguishing fire, et cetera. Group G will be devoted to lighter-than-air craft

Valuable results may be expected from this well organized international gathering.

Explosion of Anesthetics

MIXTURES of air and ether, and of ethylene and air and of various other gases, occasionally explode Obviously this constitutes a hazard in an operating room where a person is inhaling such a mixture of gases It has long since been recognized that an open flame must not be kept near a source of ether vapor The first explosion that ever occurred from ethylene was due to the fact that a cautery was brought into a room after the anesthesia apparatus had been removed but some of the gas was still in the atmosphere



The rapid increase of motor coach transportation in the last few years may be traced directly to great improvements in equipment. A striking example is the new Pickwick 53-passenger day coach illustrated above. It has a 246-inch wheelbase, and is 33 feet long, eight feet wide, and nine feet ten inches high. With a full passenger complement, it weighs 25,000 pounds. As shown at the right, the motor may be easily removed from the chassis, thus facilitating rapid repairs

Recent studies indicate that electric sparks may be sufficient impulse to set off an explosion. The entire subject has been reviewed by Dr. H B Williams, who recommends the elimination of rubber from apparatus for giving anesthetics, making the equipment as far as possible conductive throughout. He also recommends metallic tubing and a general connection of the face piece to the tubing so that when removed from the face piece the upper part of the mask will remain in electrical connection with it. In this manner, the entire apparatus can be kept at a uniform electrical potential and no high voltage is likely to develop even if the apparatus is not grounded.

Among other precautions for preventing explosions are the following directions.

There should be provision for grounding the operating room personnel, to prevent sparks passing from their persons to the apparatus, which is more likely to occur in winter weather and in severe climates. If rubber soled shoes are worn, rivets of copper may be put through from inside to outside. Great care must be exercised in placing blankets removed from a warming closet on the patient. These, if very dry, may cause copious and intense sparks when unfolded or shaken. They might well be kept from becoming so dry. Blankets of wool may contain surprisingly large quantities of water without feeling damp, they may, in other words, be damp enough greatly to diminish the hazard of electric sparks without being in the condition popularly described as a "wet blanket."

Ethylene should under no circumstances be used in any operation in which an actual cautery or surgical diathermy apparatus is to be used, and ether should never be used in any throat operation in which a cautery or surgical diathermy or similar apparatus is required Care should be taken, especially in very dry weather, not to comb or stroke the patient's hair until the ethylene has had time to become thoroughly dissipated It would be well to wrap the hair in a linen binder during and immediately after the operation —*M. F.*

"A Good Mixer" Welcomed in Industries

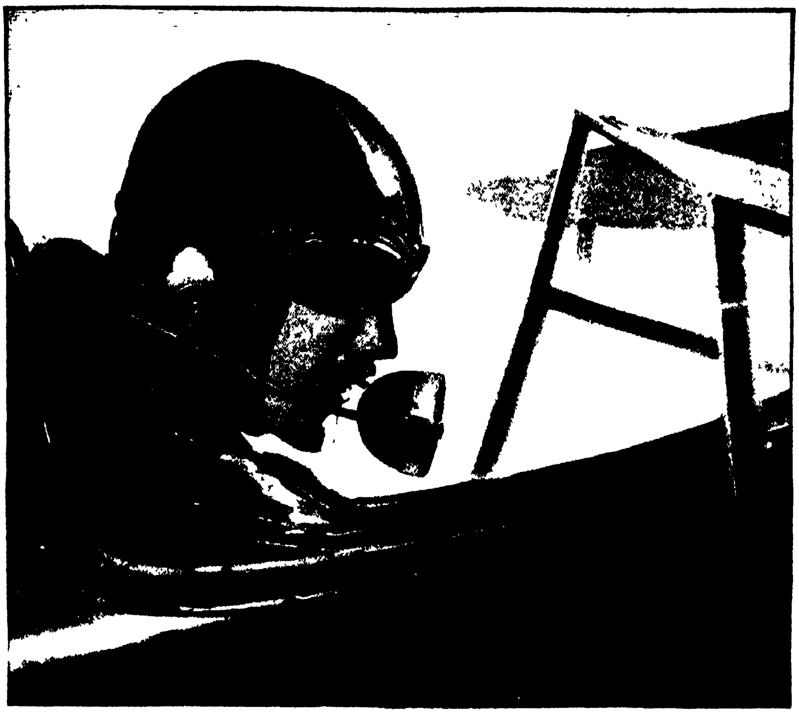
THE word "emulsion" always brings first to our mind a certain patent tonic which we were bribed and cajoled into taking before meals in the fast receding days of childhood. Emulsions, however, play a very important and ubiquitous part in a great many commercial products which are not related to medicine. The suspension and dispersion of fats, oils, and waxes in a liquid medium with which they are not naturally miscible is a basic step in the manufacture of a wide variety of useful substances. For this reason, the recent discovery that the compound, triethanolamine induces emulsification to an astonishing degree, is of prime importance.

Ordinarily, emulsification has been accomplished by slow mixing and vigorous stirring In contrast, when an oil solution of a fatty acid is added to a water solution of triethanolamine, an emulsion tends to be formed spontaneously. This method, therefore, consists in simply dissolving in the oil approximately 6 to 20 percent of the fatty acid, which includes any free fatty acid naturally occurring in the oil, and mixing the solution with a 2 to 8 percent solution of triethanolamine in water. This method usually yields a spontaneous emulsion which is converted by moderate agitation into a product of satisfactory stability If a minimum of the water solution is used, a concentrated emulsion results which is capable of storage indefinitely without separation, and which may be diluted readily with more water when desired for use.

Low-viscosity mineral oils not only can be emulsified by this method, but they can be made up as "soluble oils" There is a wide application for soluble mineral oils. They form the basis for machine cutting oils, for orchard sprays, for polishes, and for a number of textile oils.

The most interesting field for these oils, perhaps, is in the textile industry. Although mineral oils are theoretically best fitted for textile lubricants, they have hitherto been at a disadvantage due to the great difficulty experienced in removing them completely out of the finished cloth. Oils prepared with triethanolamine overcome this difficulty, and tests have shown that the above soluble oils, even after several weeks of aging in the cloth, are readily emulsified and removed with pure water.

The linseed-oil emulsions offer very interesting applications. Inasmuch as most boiled oils have an appreciable content of free fatty acid, emulsions may be made with the addition of only triethanolamine in the amount of 0.5 percent. Such emulsions, in the water phase, are used as the base for paints that are required to be of exceptionally low fire hazard, and for



Out of the storm

—*by telephone*

WITH his Western Electric radio telephone the pilot talks with the airport and receives directions for avoiding the storm.

He also hears Government weather reports and directional radio beacon signals which guide him through darkness, clouds or fog.

This equipment, keeping plane and ground in constant touch, marks a great step ahead in flying. It helps to put the new mode of travel on a dependable, efficient basis—doing for air transportation what telegraph, telephone and wireless have done for railroads and steamship lines.

The airplane telephone is backed by more than 50 years' experience with problems of voice transmission.

It was designed by Bell Telephone Laboratories and tested under actual flying conditions in their own planes. It is made with the same care and skill as all the Western Electric apparatus used by the Bell System.

When you travel or ship goods by air, ask whether the plane is equipped with Western Electric Airplane Telephone.

Western Electric

MADE BY
THE MAKERS OF
BELL TELEPHONES

Aviation Communication Systems

paints, such as are used for lettering asphalt, which must have no solvent effect on the under-surface.

Wax emulsions are finding a growing use due to their increased cheapness and low fire hazard compared with hydrocarbon solutions, especially since coating and polishing operations can be performed practically as readily with either type of dilution. A paraffin emulsion has been applied successfully to the coating of paper, board, and window shades and a carnauba emulsion to leather and linoleum. Together with other constituents they have a wide variety of applications. As an example, the carnauba wax emulsion has been made up with turpentine and nigrosines to give an excellent shoe polish with cleaning, scouring, polishing, and blacking properties.

The kerosene emulsion is especially interesting as a tree-spraying material. It may be made in a very stable form with a concentration of kerosene up to 85 percent of the oil by volume and readily dilutable with water; in this respect, at least, it is far superior to the usual orchard sprays.

Further emulsions which have been made with triethanolamine confirm its general utility in this field. A number of edible oils, such as olive, castor, and refined oils, the palatability of which is greatly increased by emulsification, are readily emulsified with this base, although they may not be recommended for internal use until the physiological inertness of triethanolamine has been confirmed.—*A. E. B.*

Art as Sales Stimulant

THE growing importance of art in commerce as exemplified in the increasing attention on the part of manufacturers to improve the appearance of products was emphasized by the Secretary of Commerce, Robert P. Lamont, in an address before the annual convention of the American Federation of Arts in Washington.

Mr. Lamont said that more and more people are realizing the association of art to everyday life and that this association is manifesting itself in the minds of designers and producers of merchandise. The incorporation of beauty through color and form into the products of our industry should increase the market for our goods.

Measuring the Oilyness of Oil

THE accompanying illustration shows W. C. Wilharm, Research Laboratories, Westinghouse Electric and Manufacturing Company, demonstrating to a visitor the device he has developed for measuring the oilyness of oil.

The device consists of a weighted platform supported by three highly polished steel balls and resting on an equally highly polished steel plate which is covered with a film of oil. The steel balls cut through the fluid film and rest on the tightly absorbed film built up by certain molecules present in the lubricant. The plate is fastened to a hinged platform which is raised slowly by means of the crank which Mr. Wilharm is shown turning in the photograph.

Demonstrating a device designed to measure the oilyness of oil

Thus, the angle between the plate and the horizontal is increased gradually until the weighted platform supported by the steel balls moves, slipping over the absorbed film of molecules. The slightest movement of the platform is rendered perceptible by the action of a voltmeter connected in a circuit which is closed when the platform comes in contact with a needle after moving only .001 inch. The tangent of the angle between the plate and the horizontal attained when the platform begins to slide is the coefficient of friction.

In this way, the device, determining the angle at which the balls will slide over their absorbed film of lubricant molecules, measures the oilyness of the oil. Of course, the smaller this angle, the greater the oilyness and the better the oil for lubrication purposes.

Rural Radios

A RADIO in every country home is the wish of the Virginia commissioner of agriculture, George W. Koiner, as expressed in a statement just issued.

"It is stated that 35 percent of the farmers have radios," Mr. Koiner said. "In some sections there are more than in others. The radio is a great boon to the isolated country home. The best music in the great cities may be brought to the home which could never be heard otherwise. Also the important market news and the interesting sporting news for both the old and the young. We wish there could be a radio in every country home."

Is Private Flying Dangerous?

EARLE OVINGTON was the first airmail pilot (1911). He is President of the Early Birdmen, a semi-serious, semi-humorous secret society and he has kept up-to-date by recently securing a transport pilot's license. His views on private flying, as expressed before the Seattle Aeronautical Meeting of the American Society of Mechanical Engineers are therefore, though somewhat pessimistic, worthy of serious consideration.

Mr. Ovington asks "Why are there so few private owners of airplanes?" and continues: "I will answer this question by saying: because the airplane really suitable for the private owner, has yet to make its appearance " Perhaps the readers of these columns will disagree with Mr. Ovington—practical light planes are with us already, in the opinion of many observers.

His views on certain desirable characteristics of the light plane are far less open to controversy.

He would like to have:

Perfect visibility.

The pilot's seat as far as possible from the engine, to minimize crash hazard.

A smooth six-in-line, inverted, air-cooled engine.

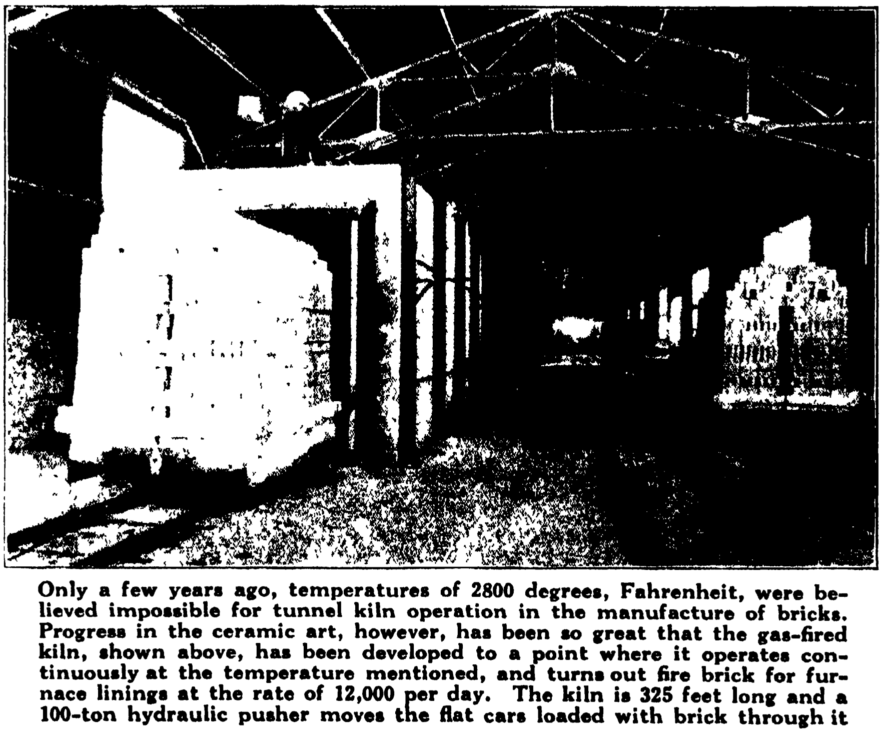
A landing speed far lower than that of the conventional airplane of today. A private plane should not land at the speed of an express train.

Perfect stability.

No dangerous stalling.

No noise.

He does not consider less cost im-



Only a few years ago, temperatures of 2800 degrees, Fahrenheit, were believed impossible for tunnel kiln operation in the manufacture of bricks. Progress in the ceramic art, however, has been so great that the gas-fired kiln, shown above, has been developed to a point where it operates continuously at the temperature mentioned, and turns out fire brick for furnace linings at the rate of 12,000 per day. The kiln is 325 feet long and a 100-ton hydraulic pusher moves the flat cars loaded with brick through it

POWERFUL LITTLE DROPS

A GALLON of Ethyl Gasoline contains only about a teaspoonful of Ethyl fluid. Yet these few drops change the action of the fuel entirely when it gets inside the cylinder.

Ethyl fluid is a governor of combustion. With increased compression, the gasoline tends to burn abnormally and the engine "knocks." Ethyl fluid regulates the combustion so that instead of a sharp irregular explosion that *slaps* the piston downward, Ethyl Gasoline burns with slowly gathering force that develops a powerful *thrust.*

That's why Ethyl Gasoline gives so much more power. That's why it develops the maximum efficiency of the new high-compression motors. That's why it stops "knocking" and gets additional power out of every automobile.

Just a few drops of Ethyl fluid, but they are *powerful drops.*

Try Ethyl. Try it on hills, in traffic, under the most trying driving conditions. Ethyl will improve the performance of your car, whatever its size, type or age. Fill up with Ethyl at any pump bearing the emblem shown below. Ethyl Gasoline Corporation, Chrysler Building, New York City.

The active ingredient used in Ethyl fluid is lead.

ETHYL
ETHYL GASOLINE CORPORATION
NEW YORK, U.S.A.
Knocks out that "knock"

Wherever you drive—whatever the oil company's name or brand associated with it—*any* pump bearing the Ethyl emblem represents quality gasoline of high anti-knock rating

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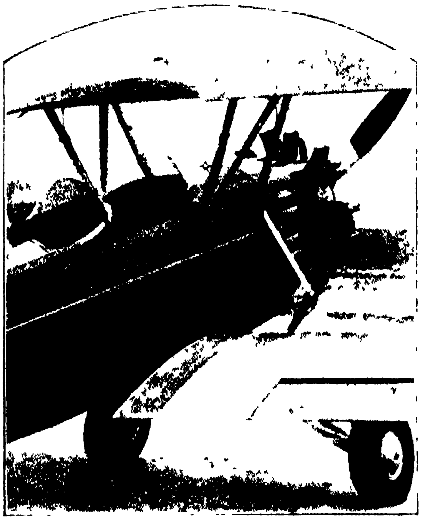
GOOD GASOLINE + ETHYL FLUID = ETHYL GASOLINE

portant. It is more safety that we want.

Mr. Ovington believes that the Curtiss *Tanager*, winner of the Guggenheim Safe-Aircraft competition is a step in the right direction, though far from being an ideal plane.



Two complete sets of instruments and controls are mounted in the cockpits of this new sport trainer

Comparing the safety of private flying with that of regular air-transport flying, Mr Ovington gives the transport service the best of the argument

"When you fly on a schedule airline, the circumstances usually are 'right.' The pilot is well trained, his experience has been extensive, the plane is the best obtainable, its mechanical condition is everything that could be desired, the airway is well known to the pilot; emergency landing fields and airports are usually frequent along the route; and undue risk is not usually taken on account of weather conditions.

"In private flying, the pilot often is not well trained, his experience is often inadequate in spite of the fact that he must pass the Department of Commerce tests in order to get his license, his ship, so far as design and construction is concerned, does not always compare favorably with the large air transports, and its mechanical condition is not always perfect, because the private owner does not, as a rule, follow an airway, landing fields and service stations are not always convenient. Only when it comes to weather conditions is the private owner better off than the air-transport pilot; the private owner is usually a fair-weather pilot· and largely avoids weather risks."

On the other hand Mr. Ovington has quite a splendid time with his own plane This veteran pilot paints a glowing and interesting picture, particularly for the man who is mechanically inclined. He does his own servicing, adjusting, and grooming His airplane is a hobby with him "I'm never happier than when I'm in my hangar, unless it be when flying my always well-groomed ship." *A. K.*

Rheumatic Fever

RHEUMATIC fever is responsible for at least one half of all cases of heart disease and the death rate for heart disease in the United States is more than twice that of the second greatest cause of death. For this reason, research on heart disease is attracting more and more investigators throughout the world. Coombs, who has studied the disease extensively in England, is convinced that children acquire rheumatism because defects of inheritance and environment combine to permit invasion of the germs that takes place through the tonsils in at least one third of the cases. Miller of England places special emphasis on the living conditions, finding this disease particularly in poor and damp neighborhoods.

All authorities are agreed that the chief hope of control of these conditions is early recognition and considerable attention to such early signs as pains in the limbs known as "growing pains," slight rise in temperature, and fatigue. Whenever the tonsils are infected, the heart must be examined repeatedly to find out whether or not it is involved in the infection Miller warns particularly about watching the pale, tired child with poor appetite, who looks feverish and sick and who has a little fever at night

In view of the lack of knowledge as to the actual cause of this disease and of the way in which children are infected, it becomes obvious that the attack upon it must be made from every possible point of view In modern research, biology, chemistry, bacteriology, pathology, and all of the other related fundamental medical sciences, are brought to bear in searching for the solution of any disease problem.—*M. F.*

A Neat Sport Trainer

THE aircraft industry is peculiar in that the training of students is one of its most important activities. But some day flying will become so easy to learn that airplane trainers will disappear. For the present, however, the number of training planes built per year equals, if it does not exceed, the number of all other airplane types. However, as flying becomes gradually a private owner's affair, the attempt is made by designers to combine the functions of a trainer with that of a sport machine Hence the name "Sport Trainer" for the new two-seater biplane built by the Verville Aircraft Company It is an excellent example of what our manufacturers can do at their best.

In the matter of equipment, for example, much more is available now than in the early days of cockpits empty of everything but seat, control wheel, and rudder bar.

The Sport Trainer calls for the following accessories standard steel propeller; Heywood air starter; balloon wheels; dual A. P. C. brakes; oildraulic shock absorbers; fully casterable tail wheel, dual stick control, parachute seats; head-rest, two 3-piece safety glass windshields, gasoline gage, tool compartment and kit, air speed indicator, two tachometers, compass, two altimeters, two oil pressure-gages; navigation lights, dry battery, fire extinguisher, first aid kit, dual throttles, dual switches, dual stabilizer adjustment, and baggage compartment. The brakes can be controlled from either cockpit, separately or simultaneously.

The reader will note the repetition of the word dual For many years there was a controversy as to the installation of instruments in a training plane. Designers argued that the same instruments should be seen by both instructor and student, and that the student did not need to have all controls under his command at the start This resulted in peculiar arrangements of the instrument board So that both occupants could see them, they were sometimes mounted on the trailing edge of the upper wing, sometimes at the side of the fuselage, and in other unlikely locations. With improvement in instrument construction, so that two sets of instruments can be relied upon to read exactly alike, duality has apparently won out.

The specifications of the Trainer are as follows· Span, 31 feet; length over-all, 24 feet 3½ inches, height over-all, 8 feet 9 inches, power plant, Continental A-70, 165 horsepower at 2000 revolutions per minute; fuel capacity, 36 gallons, fuel consumption at crusing speed 9 gallons, normal range, 328 miles, wing loading, 9 27 pounds per square foot, power loading, 13 6 pounds per horsepower, pay load, 420 pounds, weight empty, 1562 pounds, gross weight, 2243 pounds, high speed, 115 miles per hour, climb, 900 feet per minute, cruising speed, 95 miles per hour.

The arrangement of the cockpits in a training plane is most important There should be good vision forward and down. It should be easily possible to make a parachute jump from either cockpit. If our reader will imagine himself seated in either cockpit, he will see that both objectives are attained. There should be,

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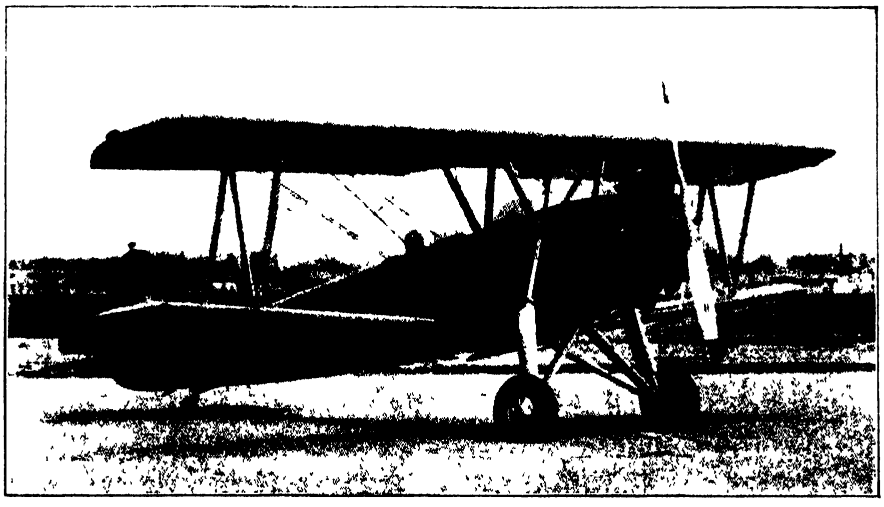
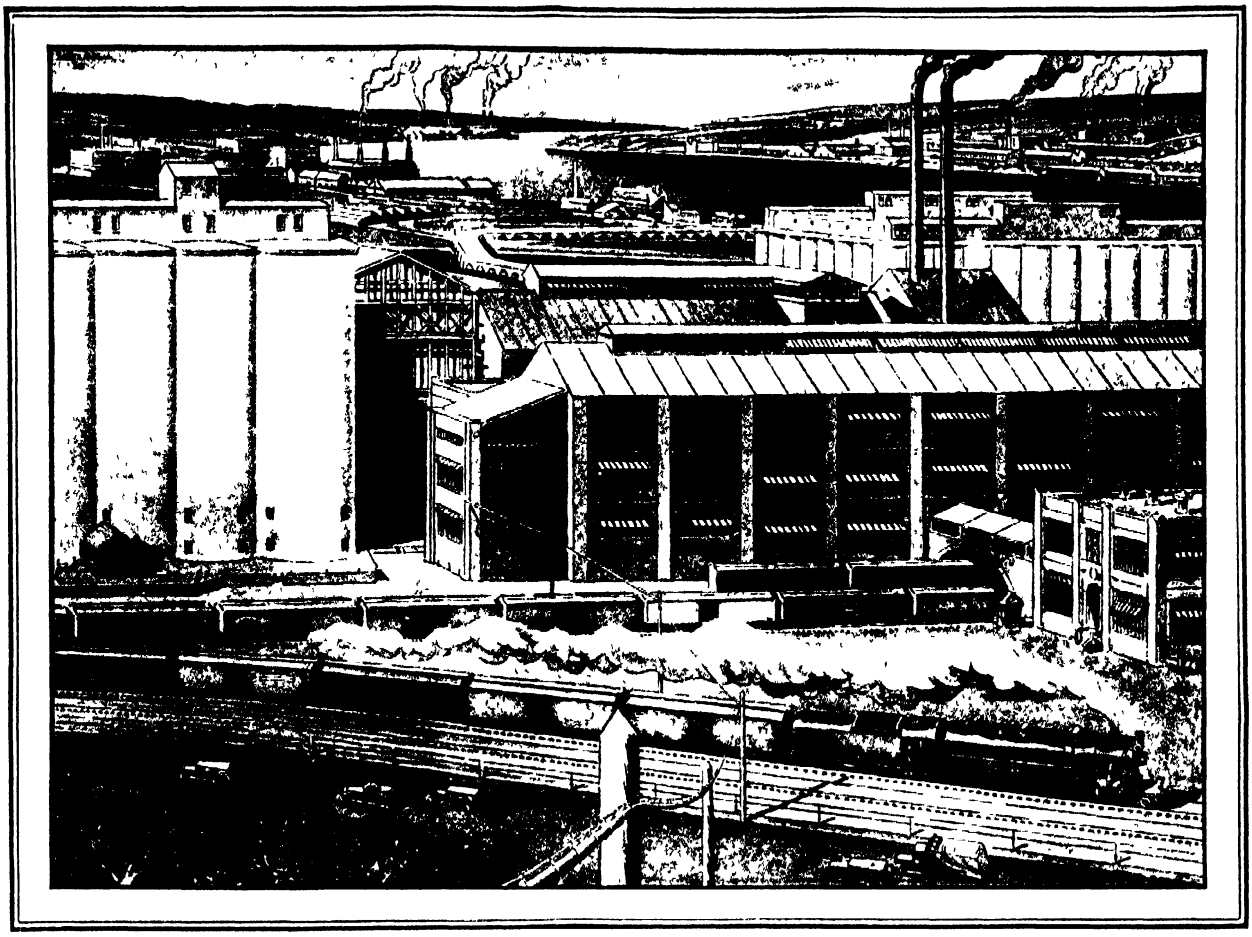


A three-quarter front view of the Verville sport trainer



Giants out of the earth

An Advertisement of the American Telephone and Telegraph Company

No AGE but ours has seen so swift and complete an application of natural forces to the doing of daily tasks. Man's leaping knowledge . . . embodied in industrial plants and laboratories, airplanes and electric locomotives . . . has won new power and freedom. Machines are the symbols of a new relationship with nature. They are the servants of this civilization . . . helping men to extend the limits of their opportunities, to change the character of their life.

Americans have been pre-eminent in this change, for in whatever they do they seek to utilize nature to the utmost. They have taken the power out of the earth and from the running streams. They have made it turn the wheels of their industry and move their products by rail and road. They have made color and variety out of chemistry. They have spun metal in slim wires to carry their voices anywhere with the speed of light . . . and make neighbors of the scattered millions of America.

Joining homes and work places, towns and distant cities, the Bell Telephone System has furnished a new communication for this new age. Forwarding the growth of the nation, giving better and more complete service in advance of the demand, its function has become the indispensable one of furnishing the means of social and business contacts in crowded cities and scattered villages over the length and breadth of a continent.

The Bell System is constantly improving the scope, speed and accuracy of its service. Its work of contributing to the welfare and prosperity of American life goes on with increasing purpose and pace.

The Amateur Astronomer

Conducted by ALBERT G. INGALLS

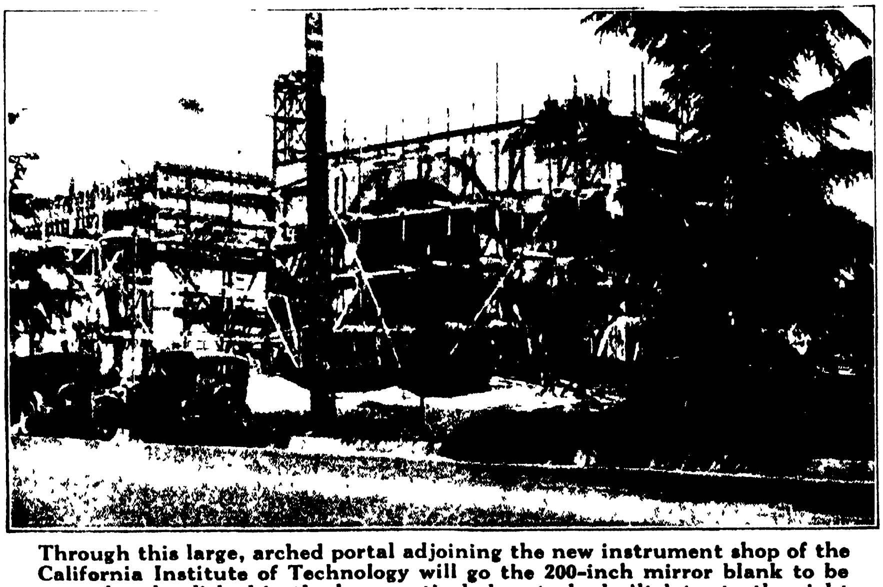
JOHN M. PIERCE, President of the "Telescope Makers of Springfield" (Vermont) estimates that 2000 telescopes actually have been made since 1926 when this journal opened its amateur telescope making campaign. That figures about 30 percent of those who have obtained the SCIENTIFIC AMERICAN instruction book "Amateur Telescope Making" and is a good showing when the unusually exacting nature of this work is considered.

Telescope making is not a hobby which is likely to appeal to the masses; it is a little too stiff for them. It recently was tried on the readers of several newspapers, who were given a syndicated series of simple "how-to-make" instructions for a reflector. The results, to put it mildly, were nothing to shout about. (Recently, by the way, we stated in these columns that amateur telescope making was too stiff for boys as well as average newspaper readers and several of our readers took the word boys to connote all minors. Perhaps "kids" was the intended word. One might say the dividing line between the "too-stiff-fors" and the "not-too-stiff-fors" is plane geometry. If a lad has studied geometry, nothing in the amateur telescope making hobby should stump him, other things being equal namely that he be fairly handy and a bit more "stick-to-it-ive" than the average lad.)

One of the six 4-inch refractors designed by Porter for use on *Polaris* to study "seeing" by Anderson's method at several sites in California and Arizona with a view to selecting a suitable location for the 200-inch telescope. Two larger telescopes will be used in the final tests at a later date

The Telescope Makers of Springfield erecting the new Porter turret telescope

Another gratifying evidence of the consistent, even if not meteoric, spread of the amateur astronomical and telescope making hobby was the attendance at the yearly "get-together" of the worst addicts the flea-bitten regulars who take telescope making instead of their meals—held last month at "Stellafane," near Springfield, in the hills of southeastern Vermont. As these words are written (in a jiggling Pullman berth) the fifth of these annual conclaves is just over and, despite the frowns of bad weather, more visiting fans from neighboring states attended than on any of the previous occasions. Running down the list of registrants one sees a well scattered following, as connoted by their home towns, Newport, New London, Boston, Pittsfield, Brookline—all places in nearby New England; also New York, Princeton, Philadelphia, Rochester, Pittsburgh, and Detroit. A special contingent came from Pittsburgh, representing the thriving association of amateur telescope makers recently organized there.



Through this large, arched portal adjoining the new instrument shop of the California Institute of Technology will go the 200-inch mirror blank to be ground and polished in the large optical shop to be built later to the right

As usual there was a Saturday evening "feed," although the time-hallowed "piece of resistance," real beanhole beans, did not materialize. The evening meal stowed away, the assembled enthusiasts listened to a talk by Russell W. Porter, Associate in Optics and Instrument Design on the staff of the California Institute of Technology. Mr. Porter spoke on, or rather "around," the subject of the great 200-inch telescope. Nearly all the extant plans are tentative and therefore little of a definite nature may be told about them as yet. We reproduce two photographs showing the first tangible beginnings, but the mammoth telescope doubtless will be many years in the making.

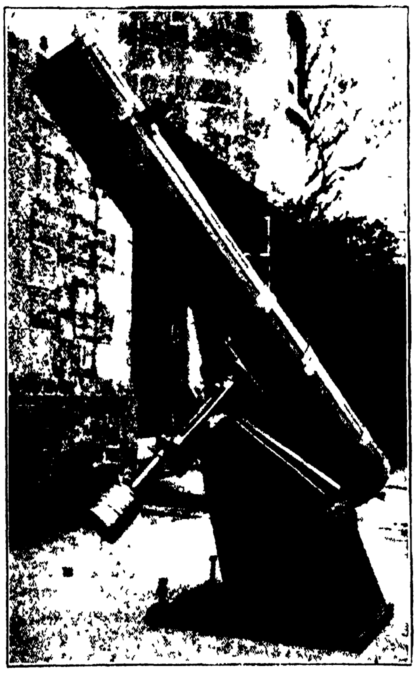
The small testing telescope shown is equipped with gooseneck prism and an eyepiece which is essentially a compound microscope giving a magnification of 7500 diameters. The quality of seeing afforded at a number of sites which are under careful investigation is determined by ascertaining the number of diffraction rings visible around the central disk of a star and how much the image of a star shifts, in terms of its diameter, when local atmospheric disturbances affect it. The star *Polaris* is the test star. Any other star would suffice, but careful study of the picture will show that the telescopes were designed especially for use on *Polaris* because that star remains for all practical purposes at the same place all night—in other words the use of *Polaris* is a matter of convenience.

As other new facts concerning progress on the 200-inch telescope become available for publication this journal will endeavor to report them.

The telescope enthusiasts, convened at "Stellafane," obtained a glimpse of the new Porter turret telescope—"new" only because recently set up (see one of the illustrations, which shows the work in progress just before the meeting; also see "Amateur Telescope Making," second edition, page 51, illustration at VI). We hope to publish a picture in a later issue, showing the complete mounting.

The turret, made of concrete, will house two telescopes, the larger one a Porter combination having a 16-inch paraboloid and a 16-inch flat, focal ratio *f* 13; the smaller one a 12-inch Cassegrainian with *e. f. l.* of 4 on 4, or *f* 16 The rings of the turret are of iron and have an external diameter of seven feet; they show toward the lower right. In the foreground is the long arm, made of tubing, to carry the 16-inch paraboloidal mirror. It, with the iron ring, dome, and counterweight, will weigh about 4000 pounds

The picture shows "the boys" at work erecting the telescope. Porter, the gang boss, is the figure with the long stogie; the rest are working especially Pierce, whose hat alone is visible (on the skyline) while he compacts the concrete in the forms with his feet. The photograph was taken by Oscar S. Marshall In the background is Ascutney Mountain. Next year when you come to the Sixth Annual Astronomical Riot at "Stellafane" the new Porter turret telescope will be ready for you to use.



An 8½-inch reflector recently built for Senor Jose Fernandez of Argentina, by the Reverend Mr. W. A. Ellison of Armagh Observatory, who did not send further description. The roof of Ellison's stone workshop shows at right

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Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Bibliography of Aeronautics, 1928, gives the information in dictionary form with author and subject entry and one alphabetical arrangement Citations of the publications of all nations are included in the language in which these publications originally appeared. *Superintendent of Documents, Washington, D. C.—50 cents (money order).*

Instructions for Installation and Care of Brown Electric Flow Meters (Instruction Book 214) The flow meter is an instrument of precision and must be treated as such, this book tells how. *The Brown Instrument Co of Philadelphia, Pa.—Gratis.*

Bearing Value of Soils Foundation Engineering deals with soil pressure, soil character, soils under load, soil tests, examples of failures, and so forth. The paper was prepared by C. C. Whittier. *Robert W. Hunt Company, 2200 Insurance Exchange, Chicago, Ill.—Gratis.*

European Motion Picture Industry (Trade Information Bulletin No. 694, United States Department of Commerce) gives up-to-date information such as the fact that at the end of 1929 there were 1670 European motion-picture houses wired for sound films. Continental film leaders now regard the soundfilm as the entertainment of the future and the multilingual feature as a necessity for foreign trade. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

The Bowie Method of Triangulation Adjustment in the First Order Net in the Western Part of the United States (Special Publication No. 159, Coast and Geodetic Survey, U S. Department of Commerce) by Oscar S. Adams, Senior Mathematician. *Superintendent of Documents, Washington, D. C. 10 cents (coin).*

Fertilization of Shade Trees (Bulletin No. 1, June 1930, Research Department, The Davy Tree Expert Co.) deals with the advisability of chemical fertilizers for conifers. *The Davy Tree Expert Company, Kent, Ohio.—Gratis.*

A New Method of Evaluating the Potency of Antineuritic Concentrates. (Reprint No. 1348 from the Public Health Reports), by Maurice I. Smith. A study in the chemistry of the antineuritic vitamin. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

Preventing Cracks in New Wood Floors (Leaflet No. 56, U. S. Department of Agriculture) by L. V. Teesdale, Senior Engineer, Forest Products Laboratory, Madison, Wis., gives valuable information as to cause and prevention of floor cracks. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

Sectional Map Indicating Main Automobile Roads Between Canada and the United States is divided into four sheets—Atlantic, Great Lakes, Middle West, and Pacific sheets. When ordering, indicate in which section you are interested. *Address F. C. C. Lynch, Director, Natural Resources Intelligence Service, Ottawa, Canada.—Gratis*

The Killifer Tillage System is a valuable, fully illustrated treatise on a system of soil tillage. *Killifer Manufacturing Co., 5525 Downey Road, Los Angeles, Cal.—Gratis.*

Museums, a Magazine Popularizing Museums. Edited by Ralph Clifton Smith, *Editorial Office, 3732 Van Ness St., Washington, D. C. $3.00 a year, single numbers 25 cents.*

Geology of the Eagle-Circle District, Alaska (Geological Survey Bulletin 816, Department of the Interior) by J. B. Mertie, Jr. *Superintendent of Documents, Washington, D. C.—50 cents (money order).*

Borate Mineral from the Kramer District Mohave Desert, California (Professional Paper 158-I., Geological Survey, Department of the Interior) by Waldemar T. Schaller. *Superintendent of Documents, Washington, D. C.—20 cents (coin or money order).*

Review of Legal Education in the United States and Canada for the Year 1929 by Alfred Z. Reed deals with the missing element in legal education, practical training, and ethical standards. *The Carnegie Foundation for the Advancement of Teaching, 522 Fifth Ave., New York City.—Gratis.*

Beginning the Second Century is a piece of institutional literature produced in celebration of the centennial anniversary of the invention of the platform scale by Thaddeus Fairbanks, and the founding of the company which bears his name. It is beautifully illustrated. *Fairbanks, Morse & Co., Publicity Department, 900 South Wabash Ave., Chicago, Ill.—Gratis.*

Hickory Golf Shafts (Commercial Standard CS18-29, Bureau of Standards, U. S. Department of Commerce) gives full diagrams. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

Tractor Lubrication is the title of a little monograph which shows that power economy is the ultimate objective in tractor lubrication.—*The Texas Company, 135 East 42nd St., New York City.—Gratis.*

Personnel Research Agencies (Bulletin of the United States Bureau of Labor Statistics No. 518) has been prepared by Estelle M. Stewart of the United States Department of Labor. It is a most valuable pamphlet of over 200 pages dealing briefly with such subjects as employment management, industrial relations, employment, safety, hygiene, cost of living, et cetera. *Superintendent of Documents, Washington, D. C.—35 cents (money order).*

Foreign Students and the Immigration Laws of the United States. (Bulletin No. 1, Institute of International Education) by Ruth Crawford Mitchell is a monograph on a subject on which it is rather difficult to obtain dependable information. Two editions have been called for in 1930. *Institute of International Education, Inc, 2 West 45th St., New York City.—25 cents.*

Ethnology of the Mayas of Southern and Central British Honduras (Publication 274, Anthropological Series, Vol. XVII. No. 2) by J. Eric Thompson, Assistant Curator of Central and South American Archelogy, Field Museum of Natural History. Here we have detailed anthropological studies of some of the living descendents of the ancient Mayas written in most interesting style. *Field Museum of Natural History, Chicago, Illinois.—$3.00 plus postage.*

Design for Kansas Farm Homes (Kansas State Agricultural College Bulletin, Vol. XIII. No. 10) by H. E. Wichers, is a publication (Bulletin 23) of the Engineering Experiment Station. The 102 page pamphlet gives 38 designs for houses accompanied by floor plans. It is a valuable contribution to the small home literature.—*Engineering Experiment Station, Kansas State Agricultural College, Manhattan, Kansas.—Gratis.*

Principles and Operation of Pioneer Instruments is a pamphlet containing many diagrams and is sold either alone or with a set of enlarged diagrammatic drawings which are 17 x 22 inches and are suitable for classroom or lecture use. The "manual" contains reduced copies of the diagrammatic drawings with accompanying text. *Pioneer Instrument Company, 754 Lexington Ave., Brooklyn, N. Y.—Diagrammatic Drawings and the Manual $2.50; Diagrammatic drawings only, $2.00; Manual only 75 cents.*

The Scientific American Digest

(*Continued from page* 318)

and is, a neat, heavy cowling for the front end of the fuselage. The exhaust ring and the engine as a whole should blend gracefully into the fuselage, and they do. The landing gear should have a wide tread and be rugged, and it is. The landing gear should absorb shocks readily, and it does, since it is provided with both oildraulic shock absorbers and air wheels. It should be easy to take the upper wing down, and since it is in one piece, this is easily accomplished. There should be a handy catwalk on the lower wing on either side of the fuselage, and there is. *A. K.*

New Fertilizer Reported

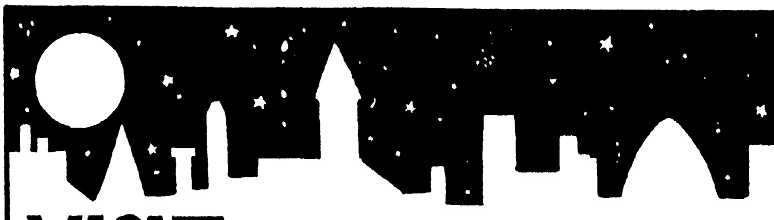
A NEW phospho-nitrogen fertilizer, obtained from a base of natural phosphates, is reported by the United States Assistant Trade Commissioner in Paris, to have been perfected by a French engineer, a technical director of one of the Algerian mining companies. Natural phosphates are treated with hydrochloric acid in the proportion of one to one. Ammonium sulfate is then added to the clear solution, the mixture filtered in order to eliminate the precipitated calcium sulfate, and calcium carbonate is then added to the filtrate. The fertilizer manufactured in this manner contains 18 percent phosphoric acid, soluble in citrate, and 14½ percent of ammoniacal nitrogen.—*A. E. B.*

Salt of the Earth Made to Fit Varied Needs

THERE is a silver thread of salt closely woven into the fabric of all human history, says Dorothy Robinson in a recent issue of *Food Industries*. It is doubtful if any commodity has had a greater effect upon the history and civilization of the peoples of the earth. Its value from ancient times is most clearly indicated, perhaps, by the prominence salt has occupied, not only in commerce but in religious and moral development. Invariably it was used in religious rites as a worthy offering, and every language has its common sayings concerning the welding of bonds of friendship through the eating of salt. Such a one is the Arab phrase "There is salt between us."

The modern salt plant, such as the one at Manistee, Michigan, described by Miss Robinson, is located over the vast underground deposits of rock salt. A pipe is sunk 2000 feet below ground and through it water is sent down to dissolve the salt. The salt solution is then pumped up into huge wooden settling tanks where some of the impurities settle out. The salt solution is then evaporated, either slowly in open vats called "grainers," or rapidly in steam heated vaccum pans. The product of the grainer is a flake salt whereas the vacuum pan produces a granular salt. The salt thus crystallized is dried and screened to obtain the many varied grades demanded by different users.

Butter makers must have a small, soft-flake salt of high purity; the cheese manufacturers desire a similar salt but of coarser grain; the canners demand a fine granulated salt to maintain color and freshness in their products; the flour manufacturers mix an exceptionally fine salt with prepared



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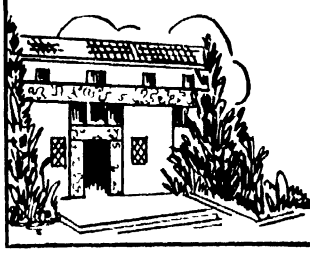

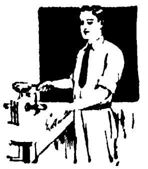

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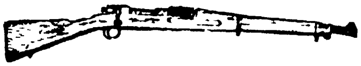

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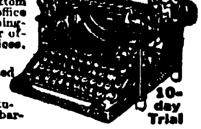

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flour. The meat packers in Chicago alone, last year, used 500,000 tons of coarse flake salt in curing and preserving meat. In other words, each manufacturer must have a salt which is adapted for his purpose, and by varying treatment of brine, methods of manufacture, drying, and screening, all of these demands can be supplied.

Even the farmer has salt put up especially for his use. Fifty-pound lots of granulated salt are dried and pressed in a large hydraulic press at 1000 tons per square inch pressure into a salt block to be used as a salt lick for cattle. For table salt, 1 percent of filler is mixed with the salt to prevent absorption of moisture and consequent hardening. For the much-advertised iodized salt, 0.02 percent of potassium iodide is added, as iodine compounds are an aid to health in the prevention of goiter.—*A. E. B.*

Alcohol As Motor Fuel

EFFORTS of the Brazilian government to popularize use of alcohol motor fuel are meeting with success, according to reports to the Department of Commerce by Assistant Trade Commissioner J. Winsor Ives, Rio de Janeiro.

Official cars are required to use this fuel and 60 percent of all cars in Pernambuco are regular consumers.

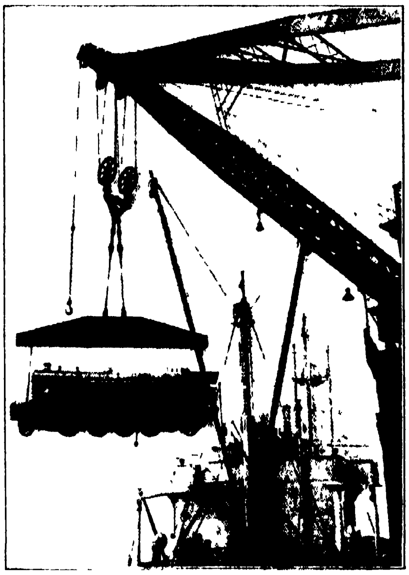
Petroleum companies maintaining branches in Pernambuco report reduced sales of gasoline due to the lower price of alcohol fuel. Alcohol motor fuel, which consists of a mixture of cane alcohol and ether, is selling from 500 to 700 reis (approximately six to eight cents) per liter, with gasoline approximately 18 cents.

Proprietary and Medicinal Foods

THE old time tonic and patent medicine has given way to the stimulating food. Years ago everyone who became depressed or fatigued or disabled in general, thought he ought to have something from a bottle to give him back the vim, vigor, and vitality that he had lost. The Food and Drugs Act and the publicity which followed its passage have made people realize the preposterousness of this belief. The newer knowledge of the vitamin has, however, brought into the situation the attempt to replace the old time products by new combinations of vitamin foods. The food faker, as has been pointed out by Dr. W. McKim Marriott, follows closely behind the investigator of nutrition, picks out an occasional truth, and distorts and broadcasts it to the unsuspecting public. Diabetic foods, pre-digested foods, and brain foods are sold with claims that are preposterous—are sold indeed with the impression that it is possible for the food to depart from the stomach and go immediately to the one portion of the body to which it may be aimed. All of the foods are reduced in the digestive tract to elemental substances, resynthesized into products that can be taken up by the blood and then distributed generally to the various parts of the body.

In addition to special foods for special portions of the body, there are products sold with a vaunting of the claims of calcium, iron, phosphorus, iodine, and all of the alphabetical vitamins. Claims are made again and again for special virtues associated with the use of certain food substances, before scientific research definitely has established the fact that the claims are warranted. Because a fresh product contains vitamins, it can not be assumed that the preserved product has retained the vitamins.

Perhaps one of the most significant phases of modern research in the canning field has been the attempt to substitute exact knowledge for guessing in the promotion of the canned food. Already it is known through research conducted in your own "laboratories" that the sun ripened tomato is much more likely to be an adequate source of vitamin C than the green product hastily ripened by artificial means. It is known that American canned tomatoes are likely to contain much more vitamins than English canned tomatoes. Because exposure to the sun's rays produce vitamin D in the body, it can not be assumed that exposure to the sun's rays or to artificial ultra-violet will produce vitamin D in every other living tissue. Unless a sufficient quantity of ergosterol, the precursor of vitamin D, is present in the tissue, exposure to ultra-violet rays will not produce the vitamin.



Although it weighs 119 tons, this locomotive is lifted like a toy to the deck of the S. S. *Belhor* by a huge 150-ton crane. The engine is destined for a railroad in India

It is also important to remember that foods must be taken into the body primarily for growth and health and not primarily for the control of disease. True, the degenerative diseases which afflict mankind are the effects of wear and tear and may be minimized by suitable control of the diet; true, the diseases due to defects of nutrition and the lack of the necessary food substances may be controlled by the provision of the missing vitamins, but in the vast majority of cases mankind eats in order to provide his body with fuel for his energy consumption and to maintain his tissues in a state of health.

Hence the folly of claiming for various natural foods special contents of infinitesimal quantities of various mineral salts and vitamins must not be permitted to dominate the manufacture of millions of cans of staple foods, of millions of packages of cereals, and of millions of pounds of meat. The statement is particularly apropos in connection with recent campaigns asserting the special value of canned foods prepared from fruits and vegetables grown in soils especially rich in iodine or iron or other mineral salts. The quantity of iron or iodine or calcium or phosphorus required by the human body is now definitely known, and it is understood among scientific nutritionists that these quantities are to be had through a vast variety of foods and that a person who eats a well balanced diet is likely to get these quantities without paying special attention to any one of these particular salts. There is no necessity for limiting the output of canned fruits and vegetables to any particular portion of the United States. Wherever these products grow in quantities and in a quality suitable for preservation, they may well be packed for preserving as part of the American diet in a season and at a time when the fresh fruits are not generally available. *M. F.*

New Finish for Aluminum

A NEW, simple, and cheap method of giving aluminum a dead white finish was described by Leon McCulloch, research chemist of the Westinghouse Electric and Manufacturing Company, in a report to the American Electro-chemical Society. The metal is boiled in milk of lime to which a little calcium sulfate is added. The new coating will be tested as a base upon which to apply paints and enamels to aluminum.—*Science Service.*

Sand as Source of Helium for Airships

MONAZITE sand, source of thoria from which gas mantles are made, may provide the lifting power for future British airships. Work at the Chemical Research Laboratory at Teddington by R. Taylor has shown that this sand is a possible source of helium, the non-inflammable gas that replaces hydrogen in American airships. The United States now has a practical monopoly of helium which is found in extractable quantities only in the natural gas of certain American gas wells. Large quantities of monazite sand are available in the British Empire, especially Ceylon and Travancore, India

The natural gas from Texas contains about 1 percent of helium, while the monazite sand yields about one cubic centimeter of helium to every gram of sand. This means that to fill a ship of 5,000,000 cubic feet capacity, the size of the *R-100*, newest of British dirigibles, 150,000 tons of sand would have to be refined. The gas escapes from the sand on heating, so in treating it for the manufacture of thoria, large quantities of helium are wasted. In the process for its refinement worked out by Mr. Taylor, the gas is treated with heated magnesium metal which removes most of the nitrogen, and then final treatment with heated calcium removes the rest of the nitrogen and other gaseous impurities *Science Service.*

Chemist Peers into Atoms With Aid of X Rays

IT is just 35 years since Roentgen discovered X rays. The application of his discovery during that time to medical diagnosis has been of inestimable value to mankind. But there is another, more recently discovered, field of usefulness for the X ray, namely the exploration of the atomic structure of matter. By the use of X rays, the scientist is permitted to "look" down into the fine structure of matter far beyond the power of any microscope. On the 35th anniversary of Roentgen's discovery, the foremost explorer of these hitherto hidden realms, Dr. George L. Clark of the University of Illinois, itemized, in *Chemical Markets*, some of the wonderful recent applications of the X ray diffraction method to industrial problems

1: Numerous determinations of proper heat treatment of metals. In one case, the X-ray results showed that at the correct temperature for annealing of cast steel parts a better structure was obtained in 30 minutes than in the six hours previously taken.

2 An improvement in the transparency of waxed paper from 40 percent that of air to over 80 percent by a simple application of the diffraction results to influences affecting the crystallization of paraffin wax.

3 A genuine improvement in the quality of rayon by fundamentally showing the structural effect of every step in the process and of adapting these to produce the necessary ultimate structure, or diffraction pattern, essential for proper tensile strength, extensibility, gloss, and so forth.

4 A method of specification for asbestos (single pattern) by comparison with standard patterns associated with practical behavior.

5 Control of addition of dyes and other agents to rubber, and of the primary effects of various treatments on colloidal size—the only method of ascertaining true reproduction of natural rubber in synthetic rubbers.

6. Measurement of particle size in paint pigments, and control of production of carbon blacks.

7 The only exact method of analysis of any material to prove whether or not it is true cellulose

8 Measurement of film thickness of every kind.

9 Determination of proper conditions for manufacture of best quality of ice-cream, as to size and distribution of ice crystals.

10. Classification and identification of precious and semi-precious stones and routine method of differentiation between fine and cultivated—containing mother-of-pearl center—pearls

These are but a very few of the remarkable achievements of the X ray when used for the study of atomic structure. So delicate is the diffraction method that the mine from which a sample of asbestos was taken is established by its X-ray photograph, as is the exact age of a growing cotton fiber or the exact process by which a rayon thread had been manufactured.—*A. E. B.*

A Rigging Handbook

SAFETY in flying depends in a large measure on plane maintenance, and this in turn depends on the skill and knowledge of the airplane mechanic. Few American books have dealt especially with the subject of airplane rigging, and we therefore welcome the "Airplane Mechanics Rigging Handbook" by Lieutenant Colonel Rutherford S. Hartz and Lieutenant Elzor E. Hall. It covers the rigging of the modern airplane in clear and simple language, is splendidly illustrated, and is written by men thoroughly conversant with their subject. In addition to covering

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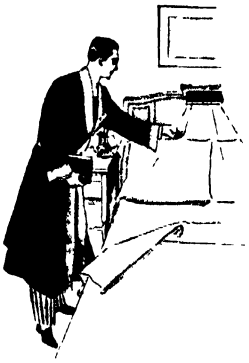

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rigging and inspection, the handbook provides a compendium of practical information on aircraft materials, wood and glue, metal airplane parts, wires, dopes, fabrics, and so forth. The care of parachutes forms a useful concluding chapter.—*A. K.*

Visualizing the Kidney

ONE of the most valuable procedures used in scientific medicine for the study of disease is the method known as "cystoscopy," whereby a tube is introduced into the bladder and the interior of the bladder studied thoroughly. In addition, it is possible to inject substances into the bladder which are opaque to the X ray and thereafter, by means of the X ray, to study the outlines of the organ.

A general examination of the kidneys is an exceedingly difficult matter. The kidneys are connected to the bladder by two tubes called the ureters and the introduction of catheters into the ureters and then to the kidney is an exceedingly painful and difficult task. It has also been necessary, if one wished to take suitable X-ray pictures of the kidneys, to inject a substance into the kidney by means of the tube introduced first into the bladder and then by the catheter into the ureter.

Several years ago Dr. Evarts Graham and his colleagues in Washington University, St. Louis, developed a dye substance which could be injected into a vein and which would then localize in the gall bladder. By this means it became possible by use of the X ray to visualize the appearance of the gall bladder. Attempts have been made over a number of years to develop a similar method for visualizing the kidney, but until recently without success. Such a method is now being discussed in medical periodicals and apparently the goal has been reached. The dye substance used is a derivative of iodine and pyrridone. The substance finally used has been developed after a dozen or more similar substances were used and discarded because of unfavorable side effects.

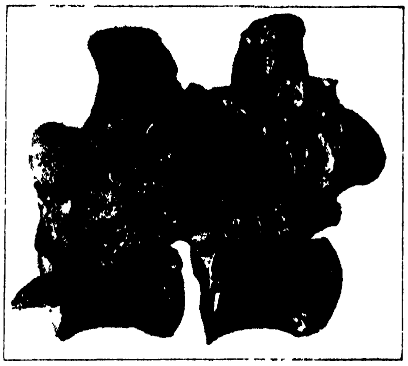
The final product, when injected into a vein, apparently is excreted in the kidney and an X-ray picture will reveal the outline of the organ. By its use in several hundreds of cases, it has been possible to diagnose the presence of cancers or tumors of the kidney, unusual formations of the kidney such as contractions or dilatations, or horseshoe shapes, and the presence of stones and other abnormalities. The method will, no doubt, make it possible, when it is fully developed, for the average practitioner to increase the certainty of his diagnosis. It will also be possible in many instances to avoid the necessity for the more complicated and difficult procedure known as cystoscopy and ureteral catheterization.—*M. F.*

Commercial and Financial Aspects of Aviation

AVIATION has gone through a tremendous boom and is now suffering an equally severe depression, at least from a financial point of view. The thousands of investors in aviation securities are seriously worried. Since knowledge is the best guide to investment or liquidation of investment, we recommend R. R. Bennett's book "Aviation, Its Commercial and Financial Aspects," to all those interested in these phases of this new industry. Published by the Ronald Press, New York City, and written by a man who has made his mark in newspaper writing on aviation, the book discusses the following subjects: The Present Status of Aviation; Safety and Dependability, Financial Aspects; Manufacture of Aircraft; Air Transportation; Airports, Aids to Navigation.—*A. K.*

Stiff Back in the Saber-tooth

THE saber-tooth, dreaded by our cave-dwelling forbears, had a stiff back as shown in the accompanying illustration of two backbone joints which are joined by a heavy bridge of bone brought on by disease or injury. Among the thousands of skeletons of the saber-tooth found in asphalt pits at Los Angeles, California, there are many which show the effects of disease, a study of which sheds light on the nature of ancient maladies. The one pictured here recalls a human disease in which the muscle of a part turns to bone, a disease which the doctors call *Myositis*. In some cases the backbone is completely solid for a distance of several inches.



The bridge of bone found on the backbone joints of a saber-tooth

Chemical Vapor Degreases Metals

AN apparatus for degreasing metal and other products prior to plating, enameling, or other finishing operations, has just been perfected as a result of the application of an ingenious chemical principle. In this process the material to be degreased is suspended in a bath of the vapor from one of a class of chlorinated solvents known under the trade name of Cecolene. The vapor, being much heavier than air, has no tendency to overflow but fills the container in which the parts to be cleaned are placed and condenses in contact with water-cooled condensers around the sides of the container and in contact with the cold objects being cleaned. It is claimed that the condensate carries all dirt and grease to the bottom of the tank where it remains in the liquid without danger of vaporization. The device is adaptable to gas, steam, or electric heating.—*A. E. B.*

British Fog Flying Experiments

SINCE England "enjoys" more fogs than any other country, the subject of fog flying is of real interest to the British Air Ministry. Its scientific staff has recently made some interesting and successful experiments in this direction, at the experimental station at Farnborough. The tests were made on a day of real fog, which extended 90 feet above the ground.

The apparatus used was simple in character. A small captive balloon was anchored 400 feet above the ground and about half a mile from the landing field. An airplane, an Avro biplane of standard make, carried a pitch, or fore-and-aft level, indicator and a turn indicator. A weight was suspended by a wire a few feet below the landing gear. The pilot left the landing field and flew above the fog, sighted the balloon and returned to the field at the appropriate gliding angle, by using his pitch indicator. When the suspended weight touched the ground, a red lamp gave him the signal for leveling out. Once the airplane left the ground it was not seen from the field until it had again landed. The experiment was repeated successfully five times and certainly adds to our knowledge of fog-flying technique. *A. K.*

New Industries from Natural Gas

THE most remarkable development of industrial chemistry within the past decade has been the large-scale production of scores of entirely new chemicals from natural gas. Chemists have learned that they can juggle the constituents of natural gas around in a great variety of ways. The decomposition of natural gas (largely methane, ethane, and propane) at high temperatures is known as pyrolysis.

When methane is subjected to temperatures of 1800 to 2200 degrees, Fahrenheit, it breaks up, or "cracks." At slightly lower temperatures the parts reunite, but form new products as they combine. The higher hydrocarbon gases also break up and reunite to give various products different from the parent substances. At sufficiently high temperatures the gases will decompose to carbon and hydrogen.

In either type of cracking, hydrogen is always set free and by suitable means can be isolated and used commercially. Its major uses are as a reducing agent in the process industries, the hydrogenation of mineral and vegetable oils and coal, the synthetic production of ammonia and fertilizers, and as a refrigerant.

Other gasses formed in the pyrolysis of natural gas are acetylene, butadiene, ethylene, propylene, and butylene. Acetylene is used in welding and cutting metal, and may be used to prepare acetaldehyde, which is further used in silvering mirrors or in the preparation of medicinals such as chloral, a soporific. Butadiene, under proper treatment, condenses to form an artificial rubber having the same general composition as natural rubber. Ethylene has recently come into use in ripening fruits. It is also finding use as an anesthetic. However, its major use at present is the synthesis of ethylene glycol, an anti-freeze for water-cooled motors, and the basis for a series of important lacquer solvents. If desired, ethylene may be converted to ethyl alcohol, widely used as a solvent, and also in the preparation of other compounds such as ether. Again, by proper reaction with chlorine, ethylene chloride is formed. This is a valuable solvent, especially for fats and essential oils, and is also used as an anesthetic. Propylene finds use as an anesthetic, and also in the synthesis of iso-propyl alcohol, which is being substituted for ethyl alcohol with good results in certain instances. Butylene is also used in the preparation of certain butyl alcohols which are finding use as solvents in the chemical industries.

The principal liquids formed in the pyrolysis of hydrocarbon gases are benzene, toluene, and xylene. Benzene is a very valuable product and forms the basis of many chemical processes. Thus are obtained aniline and the entire series of aniline dyes, and many explosives, perfumes, and medicinals. In addition benzene is an excellent solvent and anti-knock motor fuel. Toluene is the basis of the familiar T. N. T. (trinitrotoluol), of dyes, and of saccharin, a sugar substitute 400 times as sweet as sugar. Xylene is similarly used in the synthesis of dyes and other products, and also to a large extent as a solvent.

The solids resulting from pyrolysis are chiefly naphthalene and anthracene. Naphthalene is well known as an insecticide in the form of moth balls. It is also the basis for the important indigo dyes. Anthracene is used in the synthesis of alizarin dyestuffs. Finally, under certain conditions of cracking, there is obtained carbon black, widely used in making ink, in compounding rubber, and as a pigment for paint. *A. E. B.*

Electrocution

WHEN a human being is subjected for a brief period to a considerable amount of voltage of either continuous or alternating electric circuits, changes are produced in the cells of his body. An engineer, aged 60, depressed because of ill health, made contact with an alternating current at 2200 volts potential. The current passed from his left hand to his left foot, and he may have been in contact for 20 minutes. Physicians in Baltimore made an investigation of the conditions of the cells of his body six hours after death. They found that the cells of the brain were swollen and had been badly injured by the current.

A man, 21 years of age, electrocuted for murder, was submitted to a voltage of 2200 for two minutes. When his brain was examined after death the same type of changes were found.

Rats were then electrocuted and real injuries were found in the nerve cells of the brain and spinal cord. Some of the greatest changes took place in the nerve centers in that portion of the brain which controls the breathing. If the shock is slight, the interference with the breathing is temporary and it is possible by the use of artificial respiration to bring about recovery. If the shock is continued for a long period of time the changes that occur are so definite and prompt that recovery is not possible.—*M. F.*

Artificial Silk from Peanut Shells

RAYON from peanut shells is under investigation by the Farm Wastes Division of the Department of Agriculture at Arlington Farms, Virginia, with results which seem to promise a large raw-material supply for viscose producers. Over 70,000 tons of peanut hulls are collected annually in southern shelling plants, but little use is made of them except as fuel for plant power. The fact that the hulls are collected is a point in their favor, since many other types of waste which might be used could not be made available in bulk without heavy collection costs. Research

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shows that a product up to 90 percent alpha cellulose content can be derived from peanut shells, the requirement of good rayon material thus being satisfied. Experimental fibers have been produced.—*A. E. B.*

Yeast for Cows Instead of Cod-Liver Oil

YEAST, which has been exposed to ultra-violet rays, is better than cod-liver oil for increasing the rickets-preventing properties of cows' milk, Dr. Harry Steenbock, Flora Hanning, and E. B. Hart of the Wisconsin Agricultural Experiment Station at Madison, Wisconsin, have found.

These investigators have been trying for some time to find a way of increasing the anti-rachitic property of cows' milk. The majority of infants fed on it get rickets. Earlier observations showed that summer-time milk had slightly more vitamin D, the rickets-preventive, than milk produced in winter. Experiments showed, however, that it was not because the cows were getting more ultra-violet light in summer that their milk had more vitamin D in it.

Next, experiments with the cows' diet were made. Cod-liver oil, which prevents rickets in man, was not satisfactory when fed to the cows. Fed in large amounts, it lowered the secretion of butter fat. Fed in small amounts, it produced little, if any, effect of an anti-rachitic nature.

Excellent results were, however, obtained from irradiated yeast. Two hundred grams fed daily to cows producing from 30 to 40 pounds of milk increased the vitamin D content of the milk many fold. Even 50 grams furnished enough vitamin D to make the milk highly anti-rachitic.

Apparently by the use of irradiated yeast one of the most outstanding deficiencies of cows' milk can be corrected in a practical way. With the present cost of yeast production, it should be possible to give milk all the vitamin D required for normal nutrition at a cost of a fraction of a cent per quart.

The use of yeast has a further advantage in that the amount of vitamin in the milk can be controlled by the feeding of a standardized yeast preparation in amounts adjusted to the milk production.

The applicability of the use of irradiated yeast for the enrichment of human milk still remains to be worked out.—*Science Service.*

Cleansing Chemical Is "Safe" Alkali

UNTIL recently sodium metasilicate (Na_2SiO_3) had not been available commercially because of the difficulty of preparing the crystals from the sticky mother liquors and the consequent inability to prepare a granular product which would not adhere or form a hard cake on standing. Chemists have now succeeded in overcoming these commercial barriers and sodium metasilicate is available as a dry soluble powder, which keeps indefinitely in a tight container at temperatures below 60 degrees, centigrade.

Sodium metasilicate yields strictly alkaline solutions which remain effectively alkaline until they are almost completely neutralized. The solution is efficient as a cleansing agent without the disadvantages met in certain other solutions of the same high alkalinity. The material seems well adapted to cleaning all sorts of material, including glass, metals, and alloys. It also has interesting applications in the laundry. —*A. E. B.*

Shelled Nuts Form Soap Deposit in Glass Jars

THE mystery of the frostlike deposit frequently seen on the inside of glass jars containing shelled pecans, or other nuts, has been solved by E. K. Nelson and H. H Mottern, chemists of the United States Department of Agriculture. The deposit is soap, the chemists say, and it is formed by the action of the acid fat of the nuts on the alkali of the glass. It causes considerable financial loss in the sale of the product.

The unexplained presence of the soapy deposit has long been a source of annoyance to packers of shelled nuts and to some housewives in the south who put up shelled pecans in glass jars when the nuts are plentiful and inexpensive. Although the soap does not impair the quality of the nuts, it presents an unsightly appearance and reacts against the sale of the product.

The chemists first thought that the acid fat of the nuts had come in contact with minute amounts of alkaline cleaner left in the jars but this theory proved incorrect.

Further investigation showed that shelled nuts packed in ordinary glass containers formed the white deposit, whereas nuts put up in hard-glass containers at the same time and under the same conditions formed no deposit. It was concluded, therefore, that the soap was formed by the action of the nut fat on the glass.

Our Point of View

(*Continued from page* 253)

in their vigorous attacks on the treaty. But most Americans felt that, taking all matters into consideration, it was a good treaty. We think they reconciled themselves to this treaty in the firm belief that President Hoover would put the whole force of the administration behind a building program that would give the nation the maximum navy it is entitled to have under the treaty. In as much as the ratification of this treaty is a personal triumph for Mr. Hoover, the vigorous prosecution of the building program becomes a personal obligation of the President and his administration.

CONGRESS AND PARLIAMENT CONGRESS and Parliament adjourned almost simultaneously and neither had succeeded in accomplishing its major objectives. Despite the earnest efforts of the Congressionally-created Farm Board, the price of wheat and cotton is lower than last autumn, and the Labor Government in Great Britain, although unhampered by either the Conservatives or Liberals, has not only entirely failed to reduce the number of unemployed but has seen them increase by over 200,000. These two failures should warn the peoples of both countries that there is definite limitation to the powers of government to interfere with economic laws. There is truth in the homely old adage that God helps those who help themselves, and nothing so becomes a nation as the sturdy self-reliance of its industrial citizens.

BRITISH EMPIRE FREE TRADE AMONG the panaceas urged for its commercial depression is a tariff wall for the British Empire. To avoid offending the Free-Traders, this new proposal for an empire preferential tariff is euphoniously called "Empire Free Trade," but the essence of the system is a tariff against the rest of the world. The difficulties in creating such a system can be estimated by recalling the difficulties encountered by the Republican leaders in passing the last tariff bill through our Congress. All the struggles between the industrial and agricultural parts of the United States are foreshadowed on a larger scale between the industrial United Kingdom and her agricultural dominions. To obtain a preferential market for the products of her factories in her dominions, the United Kingdom must give them a compensating preferential market for their agricultural products. This means a food tax. And neither the Labor nor the Liberal party is prepared for such a departure from traditional British policy.

Even if the United Kingdom were willing to submit to a food tax it is doubtful if the Dominions would be willing to give British factory products much preference, for Canada, Australasia, and the Union of South Africa are all seeking to protect and expand their own infant industries. A Canadian leader expressed this idea very vigorously when he said in substance "A factory in Montreal strengthens the British Empire as much as a factory in Manchester"

In spite of the difficulties to be encountered in establishing reciprocity throughout the British Empire, many British readers, mostly among the Conservatives, are convinced that it offers the only solution for British unemployment. Much will be heard on the subject in the near future. As Canada and the United Kingdom are among our leading customers, our interest in the outcome is apparent.

OCEAN LINER COMPETITION WHILE the Naval Conference has placed definite limitations on naval competition, the struggle between the leading merchant navies of the world is proceeding at a faster pace than ever. It is noteworthy that in every case the governments of the competing countries are solidly supporting the private companies building and operating merchant vessels. Great Britain, Germany, and Japan have long subsidized their merchant marines, more recently France has also. Italy and the United States have come to the assistance of their commercial fleets. At present the British Cunard line, especially aided by the government, is planning a vessel that will be speedier than the German *Bremen*, and the French Government recently increased its aid to the French company that is engaged in building a liner, especially designed to add new luster to the French Line.

These wonderful liners, the western terminal of which is and will be New York, directly and indirectly add to the commercial prestige of a state and, in time of war, can readily be converted into auxiliary cruisers, or in some instances into aircraft carriers. Small wonder then that, in these days when governments realize they must help their own citizens in the competition for world markets, they willingly assist their own merchant marine. Somewhat tardily we have realized that we must give governmental aid to our merchant marine; a determined continuation of this policy will do much to regain our long-lost position of sea-traders.

As a result of our government's assistance, American private enterprise, naturally chary of competing with foreign lines, with their cheaper built and operated vessels, are consolidating and enlarging their maritime interests, and while they will encounter stiff foreign competition, we believe they can succeed as did their forbears during a similar competition in the first half of the last century. Already in the Pacific, American vessels are holding their own against foreign vessels, we confidently expect a like result in the Atlantic

THE CHAOS IN CHINA RECENTLY the U. S S. *Palos*, a small river gunboat doing patrol duty in the Yangste River, was fired upon by one of the numerous insurgent armies now laying waste their unhappy country. This incident may focus the attention of Americans for a moment on China, and it would be decidedly to their interests to give that wretched country a brief thought. China takes a large part of our silver, some wheat, and some cotton goods. With Chinese trade demoralized, naturally the demand for these articles disappears. And by so much we suffer. When to the Chinese situation is added the unsettlement of India, the other large silver market, the present low price of silver is understandable. Most of the world's silver is produced in Canada, the United States, and Mexico, and when the price of silver falls, our own silver producers and those of our two nearest neighbors and excellent customers suffer, so commercially we lose three ways.

No one can offer an off-hand solution to the problem of China, but it is plainly obvious that there will be no miraculous remedy. If the Great Powers continue to stand aloof and let the Chinese brigands calling themselves Generals continue their indiscriminate fighting and unholy looting of their own country, poor China may stew in her own juice but the supineness of the Great Powers will be somewhat punished by their reduced Chinese trade.

In these post-war days it is the fashion to condemn everything connected with pre-war diplomacy, but the old European Concert of Powers would not have tolerated the conditions that have existed for almost a decade in China. Our responsibility in China should no longer be ignored, by our insistence on the Open Door policy, quite proper in itself, we have effectually discouraged any independent European or Japanese intervention in Chinese affairs. We should, therefore, take the lead in offering some form of outside help to this distracted country which so plainly can not extricate itself by its own efforts. Our previous record of refusing to seize Chinese territory or even to accept concessions, has given the Chinese people confidence in our good will, so that they will be more inclined to accept advice and help under our sponsorship. Certainly we should not continue to watch with folded hands the ghastly struggles of our tormented neighbor across the Pacific.

Candidates for the

M EDICINE B ALL DEGREE

Now is the time to start a course in Medicine Ball. No, it isn't like drinking catnip It's a genuine sport, and, if you haven't played it, you are entirely out of style—healthfully and politically speaking For aside from being a sport much approved by President Hoover, it is one of the most muscle-building, circulation-toning, fat-removing, blues-killing, back-yard or front-walk games ever invented for sedentary man. Read all about it in the October issue of HYGEIA, the Health Magazine of the American Medical Association. Minnie Martin, who has been a Medicine Ball addict for twelve years, gives in her vivid, humorous style, a set of suggestions for making Medicine Ball a wholesome zestful recreation for exercise-starved men and women. Working for your M. B. Degree is real fun.

WHOM

shall you consult

Many people who have trouble with their eyes trot off to the jeweler who is also an optometrist and have a pair of glasses fitted They never dream that the trouble with their eyes might arise from complications in other parts of the body or that the eye, itself might require medical attention *Optician, Optometrist, Oculist, Ophthalmologist,* or *Ophthalmic Physician,* which one is the man you need? You know that each one has something to do with the treatment of the eyes but—— Dr McCoy defines these titles for you in the October HYGEIA helping to direct you to the right person for you eye troubles.

Other Health Topics

of vital interest to you

"Warm Water Healing' tells of a new treatment for paralyzed limbs, "The Antiquated Coroner System" explains a blunder in the legal processes of certain cities that is injurious to health and personal welfare, "Simple Lessons in Human Anatomy" is a "get-acquainted-with-your body" series of articles that will help in health preservation, "Questions and Answers" is a monthly section of HYGEIA that clears up the health problems of its readers—these are only a few of the health problems treated in HYGEIA Every topic is written by an authority who talks to you through HYGEIA as he would talk to a friend—in a personal heart to-heart style that makes the reader want more and more of HYGEIA Every issue is a gold mine of health information Clip the coupon fold a dollar bill in an envelope and start your subscription to good health now

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Books Selected by the Editors

AN INTRODUCTION TO THE STUDY OF WAVE MECHANICS – *By Louis de Broglie*

A COMPLETE account of the new wave mechanics, including the Heisenberg theory, written by the original theorist de Broglie (see SCIENTIFIC AMERICAN, March 1930, p. 183) who suggested the wave atom. This 216-page book, translated from the French, contains an unusually well rounded discussion of the subject, is not popular, but involves college mathematics throughout. $4.50 postpaid. —*A. G. I.*

THE FUNDAMENTAL THEORY OF ELECTRICAL ENGINEERING *By A. L. Albert, Asst. Prof. E. E., Oregon State College*

BECAUSE of the recent developments in vacuum tubes, photoelectric cells, et cetera, a text of this kind was needed to cover completely present practice in fundamental electric phenomena. This presentation is equivalent to college or university courses and will be of value as a reference for non-electrical students. $3.40 postpaid.

FUNDAMENTALS OF ARCHITECTURAL DESIGN—*By W. W. Turner*

HERE is a dependable text and a ready reference for architects. It presents a concise treatment of all the fundamental principles of architectural design. The plates give both the module and part system of measurement. Dealing with five major fields of architectural design, each of which ordinarily commands a volume for itself, this text really comprises five books in one. The vital elements of each of these fields are presented along with well-rendered drawings and a full glossary of architectural terms. $6.20 postpaid.

INFALLIBILITY is not one of the characteristics of an editor, although many of our readers apparently compliment us with this attribute. No one person, in fact, no single editorial staff, can answer every one of the diversified group of questions that come in our mail. Usually we can give some authoritative reference; sometimes on minor, unimportant queries, we must simply say we have no information, but here is one which should have an answer: "What literature is available on the dynamics of small boat sailing?" Our own references failed us. We wrote to our good friend, the Editor of *Yachting* and he replied that the older texts we ourselves located were somewhat antiquated; that a revised edition of one of the standard works would appear shortly, but at present there was nothing but the older issues.

Have patience, therefore, if we cannot always serve you, but do not hesitate to send your book queries to L. S. Treadwell who edits these pages.

ENGLISH FOR ENGINEERS—*By C. A. Naether and G. F. Richardson*

THERE is without a doubt a strong trend in engineering and industrial circles to set higher standards in the use of characteristic English. The various colleges and universities, particularly in the large centers of population, are offering courses specially prepared for the adult student. Prominent engineers are using every effort and opportunity to advocate some sort of standardization. This work is ably conceived and most carefully executed. It is a broad course readily adapted to manufacturing business generally and postulates that accuracy in any line should extend to expression as much as it is essential to the subject matter. $3.20 postpaid.

INGENIOUS MECHANISMS—*By F. D. Jones, Editor*

ONE hundred and ten designers have contributed to this collection of the most ingenius mechanisms which are commercially practical. Designers and inventors will find the classification and description of this important work of 536 pages of invaluable aid in their work. As a reference it should be kept in every technical library. We quickly placed it on our shelves. For 15 years these devices have been collected, many of them having received prizes in competition. A needed and welcome work amply illustrated. $5.25 postpaid.

HOW TO BECOME A RADIO AMATEUR

A VERY complete little booklet of 30 pages describing in detail how anyone interested in radio can take an active part in the fascinating pastime of amateur radio communication. First, something is told of the ease of constructing amateur radio equipment. Then follows a short dissertation on learning the code. A very simple yet complete vacuum tube receiver and a low powered transmitter, both for use on the "80-meter" band, are described in minute detail so that the reader can at once start construction. The latter part of the booklet is devoted to telling how the interested person can pass the necessary examination for obtaining a first grade amateur's license. For this booklet write direct to the publishers, American Radio Relay League, Hartford, Conn. 10 cents –*A. P. P.*

SCIENCE IN SOVIET RUSSIA –*By J. G. Crowther*

THE author of the unusually interesting article "Super Magnetic Fields," in the June SCIENTIFIC AMERICAN, himself a scientific man, recently visited each of Soviet Russia's scientific research institutions, testing and other laboratories and institutes, and has given his readers a clear, graspable picture showing just what actually is going on—and there really is quite a little—in science pure and applied in that strange civilization. $3.00 postpaid—*A. G. I.*

THE SKELETAL REMAINS OF EARLY MAN– *By Dr. Ales Hrdlicka, U. S. National Museum*

A NEW and noteworthy scientific treatise containing lengthy detailed descriptions of all the famous finds of ancient man: Foxhall, *Pithecanthropus*, Piltdown man, Heidelberg man, Rhodesian man, all the Neandertal skeletons, and others, by a famous authority. Suitable for the general reader. Because of its origin with the Smithsonian Institution, the volume is priced about at cost, $2.25 (unbound), otherwise it would be at least a five-dollar book. It is suggested that purchasers order it direct from the Smithsonian Institution, Washington, D. C.—*A. G. I.*

SOUND PICTURES—*By J. R. Cameron and J. F. Rider*

"THE purpose of this book is to acquaint those coming in contact with sound equipment with sufficient fundamentals pertaining to sound motion picture equipment involved at the recording and reproducing end, to enable them to assume freely the responsibilities of operation and maintainance"—so runs the foreword. It contains 1074 pages, abundantly illustrated, starting with the structure of matter and proceeding through the whole field to the very latest adjuncts and accessories. There was real need for such a work and one will quickly realize that it has been amply met here. Both authors are experts and authorities and yet the treatment is so clear and comprehen-

From Recent Publications

sive one can readily assimilate the technicalities by a little application. A most creditable accomplishment. $7.70 postpaid.

The Condensed Chemical Dictionary—*Thomas C. Gregory, Editor*

A SPLENDID reference for people not educated along chemical lines but who seek information regarding chemicals and other substance used in manufacturing and laboratory work. This second edition is completely revised, reset, and enlarged and gives a surprising amount of information in most condensed form. Many useful tables comprise the appendix. $10.20 postpaid.

Readings in Psychology *By R. H. Wheeler, Univ. of Kan.*

CAREFULLY selected passages written for the purpose of giving student beginners access to experimental investigation, selected first by what seems to be the dominant interest in psychology, and second by accessibility for publication. This is a sort of laboratory manual, with editorial notes, glossary, and index. There are seven groups in all, with a total of 28 readings. 568 pages of text $3.95 postpaid.

When I Was A Girl—*By Helen Ferris*

WELL told short biographies of Schumann-Heink, Janet Scudder, Marie Curie, Jane Addams, and Etsu Sugimoto, all of whom achieved success in spite of almost insurmountable obstacles, in the fields of music, art and social service, or science. Inspirational and most readable. $2.65 postpaid.

Evolution of the Flying Machine, Balloon, Airship, and Aeroplane—*By Harry Harper*

WITH the background of 25 years of flying, giving as it did unusual facilities for acquiring material of special interest, the author has assembled more incidents of early flight than we have yet seen under one cover. English and Continental flying is particularly well covered and a most complete chronology, especially of early attempts at flight, casualties, et cetera, completes a thorough work. $5.20 postpaid.

Twenty Thousand Miles In A Flying Boat—*By Sir Allan Cobham*

THE very entertaining and sometimes thrilling experiences of this celebrated pilot during his circuit of Africa in a large seaplane. As a messenger of goodwill, he did much to open up many hitherto inaccessible places. $2.65 postpaid.

Manual of Flight—*By Ienar E. Elm, Capt. U. S. A. (Ret.)*

KNOWN as the author of several successful technical books, here he has recorded the fundamental knowledge that should be part of the equipment of every man or woman who intends to fly. Elementary and advanced maneuvers are covered in detail and the actual hazards and safety of air travel are judiciously set forth. Emergencies are considered together with the best means of escape. An intimate and accurate outline of the art is given in most workmanlike fashion. A very practical and conclusive manual. $3.20 postpaid.

Practical Navigation *By Charles H. Cugle*

"THERE are many excellent books on the theory of navigation, but very few that the ordinary man can understand and this book has been published with theory eliminated entirely," so runs the preface. Practically everything that is needed at sea is included in this most excellent text of 574 pages innumerable examples of calculations as well as rules, deck information, examinations, stowage of cargo, et cetera. No short cuts are given, for the author believes these should be used only after thorough familiarity with the old tried and true methods. A most thorough and practical manual. $7.20 postpaid.

Exit *By Harold Bell Wright*

FOR three years no novel has issued from this author, the legends of the Papagos Indians being the intermediate title. Somehow one feels that in this present novel some of the mysticism, the intangible, the searching after inchoate realities, aspects which give fascination to Indian lore, has influenced the approach to "Exit." There seems to be less of the joyous forward looking into life which has been so characteristic of this writer; we seem to find more of introspection, spirituality, and the influences of past persons and events. Genuinely interesting from this viewpoint and as fascinating in style and description as ever. $2.00 postpaid.

Black Soil—*By Josephine Donovan*

A STORY of community life on the prairie of northwestern Iowa, consisting of several nationalities which eventually become banded by their vicissitudes and common hardships. The author is well known for her literary work along historical lines and this, her first novel, received the 2000 dollar prize offered by the publisher. Needless to say the story runs with intriguing smoothness and fluency. $2.65 postpaid.

Contemporary Immortals—*By Archibald Henderson*

WITH the keen insight of an artist and scientist, the author analyzes the lives, both purpose and accomplishment, of 12 of the most productive characters in modern affairs. Swiftly and clearly he delves to the bottom and reveals for us the salient facts which form the fundamental foundation of their impulses, their character, their accomplishment. The analytical mind of the mathematician supplemented by the culture, the language, and manners of many nations has produced one of the most delightful books we have had the pleasure of reading in many a month. Einstein, Gandhi, Edison, Mussolini, Shaw, Marconi, Addams, Wright, Paderewski, Curie, Ford, and Kipling are the sketches given. $2.65 postpaid.

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SCIENTIFIC AMERICAN
24 West 40th Street, New York City

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Adding Machine Inventor Dies

THE ranks of American inventors lost a valuable member when Dorr Eugene Felt passed away recently at his home in Chicago. Born in 1862, his mechanical bent first made itself evident at the age of 14 when he went to work in a machine shop. Early in the 80's Mr. Felt conceived the idea of the adding machine. From an old box, some metal meat skewers and a few rubber bands and staples, he evolved his first model of the machine that was destined to make an important niche for itself in the business world. From this early start Mr. Felt invented and patented numerous mechanical devices. He also found time to interest himself in other phases of science. He was an ardent student of geology and of Biblical history, both of which trends developed during his wide travels in foreign lands.

Central Radio Patent Bureau

WHAT appears to be an important step toward the solution of patent troubles in the radio industry has been taken by the Radio Manufacturers' Association. Establishment of a central patent bureau to collect and disseminate complete information on radio patents was ordered recently by the RMA Board of Directors. The new patent department will be in the New York offices in charge of a competent radio patent attorney.

An extensive library on radio patents, foreign as well as domestic, will be developed in the new patent department. It will collect, digest, and index all radio patents and publications and all information regarding patent litigation. Files of many important manufacturers who are members of the RMA will be centralized in the patent department, which will advise manufacturing members of radio suits and decisions, applications for and issuance of radio patents.

The new patent department will not participate in any patent litigation, but its patent data will be available to all members of the association.

"Gas Saver" Ad Censored

ADVERTISING in connection with the sale of a" vaporizer and decarbonizer" for automobiles that light cars run 57 miles on a gallon of gasoline, is prohibited in an order of the Federal Trade Commission to J. A. Stransky and L. G. Stransky, copartners trading under the name of J. A. Stransky Manufacturing Company at Pukwana, South Dakota.

Among other phrases contained in the company's magazine advertising was the following:

"Five hundred dollars per month selling a new patented fuel vaporizer guaranteed to save up to 50 percent in gasoline: 40 miles per gallon made with Ford car."

Representations made by the company were found to be exaggerated beyond what was possible of accomplishment as a result of the use of the "vaporizer and decarbonizer" device, and statements to the effect that the device would remove carbon, prevent spark trouble and over-heating, and make engines start easier, were found not to be substantiated in fact.

The order of the commission prohibits, among other, such representations as the following:

"Ford runs 57 miles on gallon of gasoline."

"Ford makes 40 to 57 miles to gallon; other cars show equally remarkable gains; increases power 25 to 50 percent."

"Why not buy gasoline for 10 cents per gallon? New invention. Cuts fuel bills 25 to 50 percent.

"An automobile goes 27 miles on air by using an automatic device which was installed in less than five minutes. The automobile was only making 30 miles on a gallon of gasoline, but after this remarkable invention was installed, it made better than 57."

"Makes more miles per gallon than any other device on the market, regardless of the price."

"This wonderful little device cuts the cost of gasoline in half—it made it possible for an auto to go 60 miles on a gallon of gasoline."

"Enables Ford cars to make as high as 61 miles to the gallon of gasoline."

Aircraft Patents Issued

A MISCELLANY of devices, including one design for a super-airplane combining the principles of both lighter and heavier than air craft, is included among the patents issued recently to aeronautical inventors by the United States Patent Office. The "super"-flying craft, the invention of Hugh J. Ross of Cliffwood, New Jersey, comprises a fuselage, gas bags surmounted thereon, motor driven propellers on the sides of the fuselage and means for rockably mounting the propellers on vertical axes for control from within.

Another giant airplane, but not containing the gas bag support, was patented by Bert Messick of Lansing, Mich., and an airplane with wings having air-compressing plates depending from their under surfaces at right angles was patented by George S. St. Louis of Fresno, Cal.

The late Elmer A. Sperry obtained a patent on a beacon system for night flying. Another safety device, a parachute supported by a standard, designed to bring a plane safely to earth, was patented by Frank Arnaiz of Los Angeles. An electrical heating means for airplane wings to prevent the accumulation of ice and snow is the invention of William S. Ingram of Philadelphia.

Patents covering a "means of controlling the angle of incidence of aero revolving blades or wings and propellers" were issued to David Kay of Blackford, Scotland. Martyn Clissford MacPherson of Hayes, England, obtained a patent on a "braking of the under-carriage or landing wheels of airplanes." Hugo Junkers patented a dock for flying machines, and a patent on a floating dock for seaplanes was issued to Paul Degan of Kiel-Dietrichsdorf, Germany. Another German, Otto Krell of Berlin, patented a rotable movable hangar for dirigibles.

Increasing interest in the development of lighter-than-air craft is evidenced by the number of patents pertaining to dirigibles recently issued.

Wolfgang B. Klemperer, for example, procured three patents covering a stabilizing apparatus for airships, a tensiometer, and a bulkhead for airships, collaborating on the last with Paul Helma, also of Akron, Ohio. Their patents and one issued on a gas container for airships to Karl Huerttle, together with another on a wire netting for airships to Paul Helma and Kurt Bauch, all of Akron, have been assigned to the Goodyear-Zeppelin Corporation. These technicians are among those working on the construction of two giant dirigibles for the United States Navy.

Ralph H. Upson, famous balloonist of Brooklyn, New York, procured patents on a dirigible and a type of airship fin which he has assigned to the Aircraft Development Corporation of Detroit. Charles Guidice, also of Brooklyn, designed and patented a new type of dirigible, and a patent on a device for protecting balloons from lightning and other atmospheric disturbances was granted to Alfred Crossley, Washington inventor, who has assigned his rights to the Federal Telegraph Company.

Patents on new types of parachutes have been issued to Charles H. Castagne of Chicago and Captain Edward L. Hoffman of Dayton.

Lloyd Stearman of Wichita, obtained patents on a dolly for airplanes and an air-intake heater, both of which inventions he has assigned to his Stearman Aircraft Company.

Cologne Trademark Void

IN a recent decision by the United States Circuit Court of Appeals, Judges Manton and Swan concurring and Judge Hand dissenting, it was ruled that Muelhens and Kropff, Inc., 25 West Forty-fifth Street, American manufacturers of 4711 eau de cologne, cannot have exclusive right to the use of "4711" as a trademark because the concern does not possess the original formula for the manufacture of the article.

Since 1792 the Muelhens family in Germany has been manufacturing eau de cologne at 4,711 Glockengasse, Cologne, Germany. The formula has remained a secret.

In 1878 William Kropff came to this country as the family's agent. Later a member of the Muelhens family formed a partnership here with him. The trademark "4711" was registered as belonging to the firm, but the secret formula was never revealed to Kropff.

During the World War the Alien Property Custodian seized Muelhen's interest in the firm and later sold it to Kropff. The sale included good-will and the trademark. Kropff then incorporated as Muelhens & Kropff and made and sold a cologne under the trademark "4711."

After the war, Muelhens established Ferd. Muelhens, Inc., and began selling "4711" cologne made according to the old formula. The result was that Muelhens & Kropff brought suit to prevent Ferd. Muelhens, Inc., from using the trademark.

A majority of the court decided that "assignment" of the receipt is essential to give the assignee the exclusive right to a mark which denotes a product manufactured thereunder. Otherwise the public will be unable to procure the genuine product under the name by which it has always been known.

Those who insist upon the genuine 4711 eau de cologne are not the prospective customers of the plaintiff, for he cannot supply it.

"Special" Book Editions Curbed

A BOOK publishing partnership signed a stipulation with the Federal Trade Commission agreeing, in connection with the sale of a special edition of a book, to cease and desist from using such representations as "The Authentic Text," "The First Authentic Text," or "The Complete Text" as descriptive of the edition, when in truth such statements are not supported in fact.

This firm also agreed to discontinue use of the words "authentic" and "complete" in any way that would imply or deceive the purchasing public into believing that its edition is an authentic one of Edgar Allen Poe's story entitled "The Gold Bug," or that the edition is an authentic or complete text of this story containing all of Poe's alterations and additions, when such is not the fact.

Patent Office Rules Revised

AMENDMENTS to the trademark rules and to the rules of practice of the Patent Office, made to conform to the new law (act of Apr. 11, 1930), relating to fees, and certain recommendations of the committee of the American Bar Association were announced recently by the Commissioner of Patents, Thomas E. Robertson.

"That part of the new rules which includes fees," Mr. Robertson stated, "has been changed to meet with the requirements of the new law approved Apr. 11 providing that the fee for issuing original patents shall be 25 dollars and 1 dollar for each claim in excess of 20, instead of the present fee of 20 dollars and 1 dollar for each claim in excess of 20.

"Amendments to the rules of practice of the Patent Office were made to carry out the recommendations of the patent committee of the American Bar Association. These changes are, first, an amendment to Rule 41, which provides that more than one species of invention, not to exceed three, may be claimed in one application if that application also includes an allowable claim generic to all the claimed species.

"The changes in rules 109, 114, 122, 123, 124, 128, and 130 provides that all motions in interference cases shall be heard by an examiner of interferences instead of by a law examiner as at the present time.

The American Bar Association, it was pointed out, believes that this will expedite work in interferences, lessen the trouble and expense of interferences and bring them to a speedier conclusion.

In the first sentence of rule 109, "An applicant involved in an interference may, at any time within 30 days after the preliminary statements (referred to in rule 110) of the parties have been received and approved, on motion duly made, as provided by rule 153, file an amendment to his application containing any claims which in his opinion should be made the basis of interference between himself and any of the other parties," has been taken out of the rule and supplanted by the following:

"An applicant involved in an interference may, within a time fixed by the examiner of interferences, not less than 30 days after the preliminary statements (referred to in rule 110) of the parties have been received and approved, or if a motion to dissolve the interference has been brought by another party within 30 days from the filing thereof, on motion duly made as provided by rule 153, file an amendment to his application containing any claims which in his opinion should be made the basis of interference between himself and any of the other parties."

The rules from 109 to 130 provide for the substitution of the word, "examiner of interference" for "law examiner."

Rules 162 and 163 contain changes relating to the filing of typewritten instead

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payment must accompany each insertion

Anyone desiring official copies of patents herein listed may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

Aeroplane—Having a single wing extending longitudinally of the fuselage at a sufficient height and angle to dispose the load forwardly and so balance it, as to cause the plane to come out of a fall and glide safely to earth. Patent 1769320. Henry C. Thompson.

Aircraft—Having an arrangement of supporting and flying control surfaces, by which the usual form of tail assembly can be dispensed with, and yet the craft maneuvered and maintained on a desired course and under perfect control. Patent 1766390. Charles V. Lapin.

Aeroplane Of the amphibian type, equipped with a landing gear, well adapted for water or ground, having novel features of material advantage in taking off from water, and means for preventing sleet and snow collecting upon the wings. Patent 1769393 John T Rydberg.

Pertaining to Apparel

Garment - So constructed that when worn by a patient undergoing treatment for certain diseases, parts of the garment may be adjusted so that only that part of the body effected, need be exposed to view. Patent 1766272. Samuel W. Vallier.

Chemical Processes

Process of Stabilizing Cereal Beverages —Containing less than 0.5% of alcohol, by treating the beverage, at any stage of the brewing, with tannin and a siliceous clay, to precipitate the undesirable albuminoids which render the finished beverage turbid when chilled. Patent 1766428. Donato Cozzolino.

Designs

Design for a Dress—Patent 81493. Dorothy Long.

Design for a Coat—Patent 81494. Dorothy Long.

Design for an Ensemble Suit—The inventor has been granted two patents, 81495 and 81496. Dorothy Long.

Design for a Radiator-Cap Ornament or Similar Article—Patent 81530. Guy de Vall.

Design for a Coat— Patent 81545. Dorothy Long.

Design for a Reading Cabinet—Patent 81568. Charles J. Abeles.

Design for an Ensemble Suit - The inventor has been granted two patents, numbers 81589 and 81590. Dorothy Long.

Design for Lace—Patent 81616. Ben. A. Ball.

Design for a Doll or Similar Article—Patent 81638. Adolph Gramlich.

Design for a Toy Animal—Patent 81646. John S. Hooks.

Design for a Dress—Patent 81711. Dorothy Long.

Design for a Carpet Sweeper—Patent 81669 Earle R. Smith.

Electrical Devices

Circuit-Controlling Device -Whereby special mechanism actuated by the steering apparatus of an automobile keeps the circuit of the indicating lights closed so long as the front wheels of the car remain turned in either direction. Patent 1766993. Masao Hasegawa.

Thermostatic Electric Switch—More particularly designed for controlling the illumination of one or more incandescent lamps such as are used in direction signals, in a manner to produce an automatic flashing. Patent 1766430. Clarence K. Davis and Arthur Dick.

Radio Receiver—Having means whereby the volume of output may be easily and accurately controlled from a point remote from receiving set to give desired softness or loudness, adapted for use with any type of receiving apparatus. Patent 1769256. Allen S. Clarke.

of printed briefs and records providing the brief or record does not exceed 125 pages.

"The Bar Association Committee requested that this be done to cut down printing expenses since they are now very high," Mr. Robertson said.

Bottle Trademark Denied

IN a recent decision, First Assistant Commissioner Kinnan held that the Obear-Nester Glass Company of East St. Louis, Illinois, is not entitled to register, under the Act of 1920, the words "Individually Wrapped," as a trademark for prescription bottles made of glass.

The ground of the decision is that the words could not function as a trademark. In his decision, the First Assistant Commissioner said:

"The words sought to be registered as a trademark would have no trademark significance to the purchaser of the goods nor could they have any such significance as they merely convey the plain information as to the manner in which the bottles are packed or arranged for shipment. No one could obtain the exclusive right to use these purely informative and descriptive words in connection with the sale of bottles."

"Bucyrus-Erie" Registrable

AN applicant already owning registrations for the mark "Bucyrus," under the 10-year proviso of the act of 1905, is entitled to registration as a trademark of the word "Bucyrus-Erie" for power shovels and similar articles, the Assistant Commissioner of Patents has held.

While the word "Erie" taken alone is a geographical name and therefore would not be registrable, the opinion states that the combination of the two words, linked together, are to be considered as an entirety, and therefore, the mark does not fall within the provision prohibiting the registration of merely a geographical name or term.

Mis-branded Wood

TWO corporations selling and distributing motor boats have signed stipulations with the Federal Trade Commission agreeing to stop misrepresenting their products as made of mahogany, when such is not the fact. Both companies agreed to cease use of the word "Mahogany" either independently or in connection with the word "Philippine," or in any way which may tend to deceive the public into believing that their motor boats are made in whole or in part of wood derived from trees of the mahogany family, when such is not the fact.

One of the companies also will discontinue use of statements or representations implying that it owns, operates, or controls a factory wherein are built and manufactured the products it sells.

Labels Need Not Be Detailed

THE portion of an order of the Federal Trade Commission requiring a person doing business under the firm names to state the ingredients and percentages of such ingredients which make up a substitute shellac in labels and advertisements of the product has been held by the Circuit Court of Appeals for the Second Circuit to be unwarranted.

The court stated that it would be sufficient to prevent a fraud upon the public if the respondent labels his goods and advertises the same as "shellac substitute" or "imitation shellac," accompanied by the statement that it is not 100 percent shellac, and that it was not necessary to show the ingredients of the product in their percentages.

The Federal Trade Commission had issued an order against the respondent requiring him to cease and desist from using the word "shellac" in labels and advertisements of varnish which was not composed entirely of shellac gum dissolved in alcohol. The order permitted the use of labels and advertisements in the sale of the product if accompanied by words clearly indicating the other ingredients and the percentages used. The appellate court modified the order, by eliminating the latter requirement.

Line Tester—For overhead wires, wherein the structural arrangement is of such character that effective contact with the circuits to be tested, will be made regardless of the amount of corrosion, rust, etc., with which the surface may be coated. Patent 1769248. Charles D. Williams.

Of General Interest

Window Box—Or window refrigerator, which may be easily adjusted to the sill, does not interfere with the opening or closing of the window, provides fresh air while excluding dust, and prevents cold air entering the room. Patent 1769740. John C. Kelley.

Closure Construction — For rubber pouches, hot water bags, and the like, which will be water-tight, less bulky than those in general use, and may serve with a tube so that the article may be used as a syringe. Patent 1769259. Beulah L. Henry.

Emergency Section for Ships—Which will float free if the ship should sink, accommodate all of the people carried by the ship and enough storage of food and equipment to take care of them until rescued. Patent 1768152. Charles F. Rodin.

Cigarette Case and Lighter—In combination, constructed to take up very little more room than that occupied by a standard cigarette case. The lighter is removable for permitting a new refill in the operating mechanism. Patent 1766320. Edward G. Ahrens.

Boat-Salvaging Device—Built in as a part of the boat and accessible from the deck, thereby obviating the necessity of passing cables in the mud beneath the ship bottom, for applying hoisting tackle to the sunken vessel. Patent 1769353. Louis F. Long.

Lawn Sprinkler—Embodying mechanism whereby when the device is placed at the approximate center of a square, the volume of water will be controlled so that the corners will be reached by the spray, and the lawn uniformly sprinkled. Patent 1766514. Henry L. Henry.

Sign—Constructed for interchangeably holding readable indicia in fixed position on a board, and against accidental displacement, yet allowing when desired an adjustment or spacing of the characters without removal. Patent 1766362. James A. Sears.

Envelope—Which does not require moistening in order to effectually seal it, and in which means is provided for showing at once any attempt to open the envelope. Patent 1768836. Thomas E. Gjorup.

Brush—A folding brush in which the bristles are adapted to be received when folded within a protecting housing, the whole forming a compact structure which when unfolded provides a handle and brush. Patent 1770344. Frederick E. Schmidt.

Box or Container—Formed of cardboard and composed of three main parts having flanges projecting from the sides and ends which are joined together by metal staples or other fastening means operating as a protective means against damage by dropping. Patent 1770819. Fred W. Tamke and George W. Boh.

Visible Card File—Having a transparent pocket at the end of each card holder, which will improve the use of the record slip for the permanent items relating to the record matter, and the general operation of the file. Patent 1770793. Luigi Lombardini.

Weed Puller—Having a pair of pivotally mounted jaws with ground penetrating points adapted to be moved together in gripping relation for removing weeds including their roots, with a minimum displacement of the soil. Patent 1771358. Fred P. Riddell.

1929 French Aircraft Exports Increased

FRENCH aircraft exports during 1929 increased considerably, Automotive Trade Commissioner W. L. Finger, Paris, France, recently informed the Department of Commerce. Land planes with a total value of 209,581,000 francs (approximately 8,207,411 dollars) were exported as compared with 138,898,000 francs (approximately 5,446,190 dollars) in 1928; seaplanes exported amounted to 4,852,000 francs.

The largest markets for French aircraft were Yugoslavia, Belgium-Luxemburg, Turkey, Rumania, Brazil, and Indo-China. In 1929 Yugoslavia imported from France aircraft valued at 40,290,000 francs; Belgium-Luxemburg, 2,713,000 francs, and Turkey, 2,694,000 francs. Although 1929 was the first year that France imported airplanes, the quantity was small. These planes came from Great Britain and The Netherlands.

Fraudulent Implication Stopped

CO-PARTNERS engaged in the sale and distribution of knit goods, such as sweaters, swimming suits, and knit dresses, recently signed a stipulation with the Federal Trade Commission agreeing to stop use of the words "Knitting" and "Mills" in their trade name so as to imply that they own or control a factory in which they manufacture the goods they sell.

They agreed to discontinue any other use of the two words which may have the tendency to mislead the purchasing public into the belief that these partners operate a factory.

Mine Safety

THE possibility of eliminating the use of electrical equipment in coal mines in Utah and substituting compressed air apparatus, will probably be considered by the state industrial commission, according to O. F. McShane, a member, who is investigating coal mine explosions.

It is stated that recent explosions have been caused by ignition of gas by the use of electrical equipment and Mr. McShane is serving notice on coal producers that they must show within a reasonable time that they can control this danger by introduction of new safety devices.

Compact-Holding Ring for Vanity Cases—Wherein spaced fingers are used to resiliently hold the compact plate in position, the fingers being so arranged that an implement may be placed there between for ejecting the plate. Patent 1771337. William G. Kendall.

Adjustable Handle—Whereby brushes, mops and such articles may be releasably held in different angular positions to enable a person to more conveniently carry out cleaning operations. Patent 1771325. John R. Cotter.

Device for Producing and Dispensing Lather—Having means for agitating the soap and water to produce a lather without the necessity of shaking the device, and to insure the dispensing of the lather only, precluding the discharge of water. Patent 1771292. Frank P. Gallipoli.

Ironing Board Attachment--By which those parts of garments which have been pressed, and depend from the board as a result of shifting to press other portions, are effectively supported to prevent contact with the floor and soiling. Patent 1770890. Frank Pons and Levert W. Wilson.

Hardware and Tools

Pipe Coupling and Rotary Tool Joint—In which a plurality of threaded sections are screwed into each other with the threaded sections having a differential pitch, and means for locking certain of the sections against independent rotation. Patent 1769381. Gustavus A. Montgomery.

Safety Spring--Or door closing device, having means for limiting the outward movement of a door or other hinged member, in order to protect the hinges, or any object with which the door might collide. Patent 1771299. Fred E. Justus.

Machines and Mechanical Devices

Washing Machine—Which may be connected by a hose to a house faucet and either hot or cold water used for the operation of the machine and for constantly passing clean water in contact with the clothes. Patent 1769221. Harley A W Howcott.

Tension Indicator and Compensator for Warping Carriages—For textile fabric such as rayon, silk, and fine counts of cotton, etc., particularly adapted for producing rayon because it overcomes the action of jerks on the warp sections when starting and stopping, thus avoiding stretching. Patent 1769244. William G. Trautvetter.

Variable - Speed Transmission — Which makes use of two friction discs and two friction wheels, the construction permitting the gears to be bathed in lubricant while still keeping the discs away from the lubricant, thus operating efficiently at all times. Patent 1766240. Julius L. Allen.

Jig—For separating ore or minerals from rock or lighter material, and more particularly a jig wherein a pulsating column of water is used in conjunction with a grate to effect a classification of a bed of material. Patent 1769287. Asa R. Chase.

Moulding Machine—Wherein dough can be molded into mass of the same thickness throughout, such as pan bread, of a predetermined length, or shaped to provide rolls or loaves known commercially as French or Vienna bread. Patent 17711 (reissue). Frank A. Scruggs.

Wave and Tide Motor—Characterized by a plurality of floats capable of being mounted in a body of water for movement in response to wave action, and means responsibe to variations of levels, such as resulting from tidal action. Patent 1766457. Charles H. Ruth.

Automatic Alarm Clock for Hotels—By which the occupant of any particular bedroom may be rung up at any desired hour, an electric lamp being lighted at the same time in his sight, the alarm is automatically repeated a second time. Patent 1769830. Vlderico Giomi.

Apparatus for Treating Asphaltic Oils for the Production of Asphalt—Whereby asphaltic oils can be treated to produce oxidized asphalt possessing a relatively high melting point and a relatively low degree of penetration, and the time required for distillation greatly reduced. Patent 1766446 Max R L. Miller.

Bun-Cutting Machine--In which a rotary cutter or knife is employed for cutting buns or other bakery or food products, without marring or making them objectional in appearance, the machine may be adjusted to completely sever or cut partly through Patent 1766450. John A. Ost.

Sugar Dispenser- For mechanically delivering measured quantities or any multiples thereof, the several quantities being accummulated within the dispenser and all being discharged as a single quantity by one tilting movement, the parts are readily removable for cleaning. Patent 1768091. Gus N. Adair.

Loom Mechanism- A reed-like batten with mechanism for moving the same toward and from the fell, beating up the filling as it is inserted and coincidently effecting a combing of the work shed. Patent 1770269 Benjamin D Hahn.

Lubricating Device—Including a well from which a capillary feeding element immersed in lubricant leads to the parts to be lubricated, and whereby a constant level is maintained in the well, whereby uniform feed is obtained Patent 1770036. Albert Johnson

Grinding Fixture—Capable of accurately grinding the face radius and sides of both large and small milling cutters and backing off to proper clearance in one operation, can be used on any standard machine. Patent 1770318. Andrew McAndrew.

Lock--Of the portable or "padlock" type, having a shackling element formed for general application and capable of assuming different angular positions without presenting an obstruction, but held locked against unauthorized removal. Patent 1770812. Ellsworth F. Seaman.

Vacuum and Pressure Pump—Which after reaching a constant speed will produce a definite pressure or vacuum, and once such pressure or vacuum is attained the pump will not operate to increase it beyond this maximum. Patent 1769257. Ralph G. Demaree.

Boat Davit—In which the use of blocks and tackle are eliminated, is vertically movable with the sides of the ship, maintains the boat at a fixed distance from the ship, and prevents upending of a boat during launching. Patent 1771372. Julian W. Bournier.

Dishwashing Apparatus—Having a plurality of brushes of different characters and configurations, connected for rotation with a motor shaft, whereby plates, platters, glasses and other tableware may be rapidly cleansed. Patent 1771934. Mattia Marangoni.

Washer—Having a steam jacket and heads securely bolted to the grooved rings on the ends of a cylinder, the inner face being entirely lined up with sheet nickel, particularly adapted for use in connection with the dry cleaning of clothes. Patent 1771638. Wallace C. Johnson.

Medical and Surgical Devices

Surgical Appliance—By means of which a constant temperature may be maintained with solutions such as "the Murphy drip" intravenous injections, saline and other solutions, as well as solutions for feeding the human body, and for blood transfusions. Patent 1770832. Donnie L. Bass.

Prime Movers and Their Accessories

Protecting Tray for Valve Chambers—Capable of being readily applied, and in such position as to form a protecting covering to receive and collect the carbon particles, cuttings and other waste matter, in such manner as to prevent contamination of the oil. Patent 1766469. Chauncey H. Stout.

Pertaining to Recreation

Toy—In the nature of a "hobby-horse" but differing by the employment of a structure that will produce a more bouncing motion, as well as a rocking motion, thereby exercising the abdominal, back and leg muscles. Patent 1771920. Benjamin Gordon

Pertaining to Vehicles

Automobile Door Hinge—Whereby entrance to the front and rear seats is had by way of a single door, capable of being opened on both the front and rear edges, thus facilitating ease of entrance or exit from rear or front seat. Patent 1769273. Jacob A. Penner.

Tire-Deflating Switch—A simple and efficient device which will automatically notify the user of the vehicle that he has a flat tire, or one that is partially deflated, the alarm system indicating the location of the particular tire. Patent 1769427. John B. Garside.

Fuel Meter for Automobiles—An apparatus comprising a receptacle with valves in the top and bottom, and a rod operating the valves and a float, whereby the amount of fuel consumed may be measured and registered. Patent 1766262. Claude Simmons.

Auxiliary Water-Circulating Means for Automobile Engines Using Thermo-Siphon Systems—Which will eliminate all belts, pulleys, gears, packing glands or parts that would wear or leak, and their attendant disadvantages, yet possessing a considerable means of boosting the water circulation and be easy to install. Patent 1766408. Robert F. Stephenson.

Brake Equalizer—For four wheel brakesf adapted for ready application to any type o automobile for applying the brakes while at the same time providing for an equalization of the pressure, and the proper force for stopping the vehicle. Patent 1770030. Ray Freeman.

Lubricating System — Comprising tubes leading to the different parts of an automobile, providing a lubricating system which may be actuated by electrical apparatus which includes the ignition switch. Patent 1769258. Coy C. Goodrich.

Signal Arrangement for Automobiles—Which includes a current switch, signal horn, signal lights, constructed in such a way that all signals, optical and acostic, can be separately connected or disconnected by means of one and the same current switch. Patent 1770835. John F. Bolin.

Tourist Car—With the over-all dimensions of an ordinary truck, but providing a relatively large floor space when stopped for camping, embodying indoor and outdoor sleeping quarters, comfortable transportation for travelers, convertible articles of furniture adaptable for various purposes, and observation quarters. Patent 1771911. Harry W. Bernecking.

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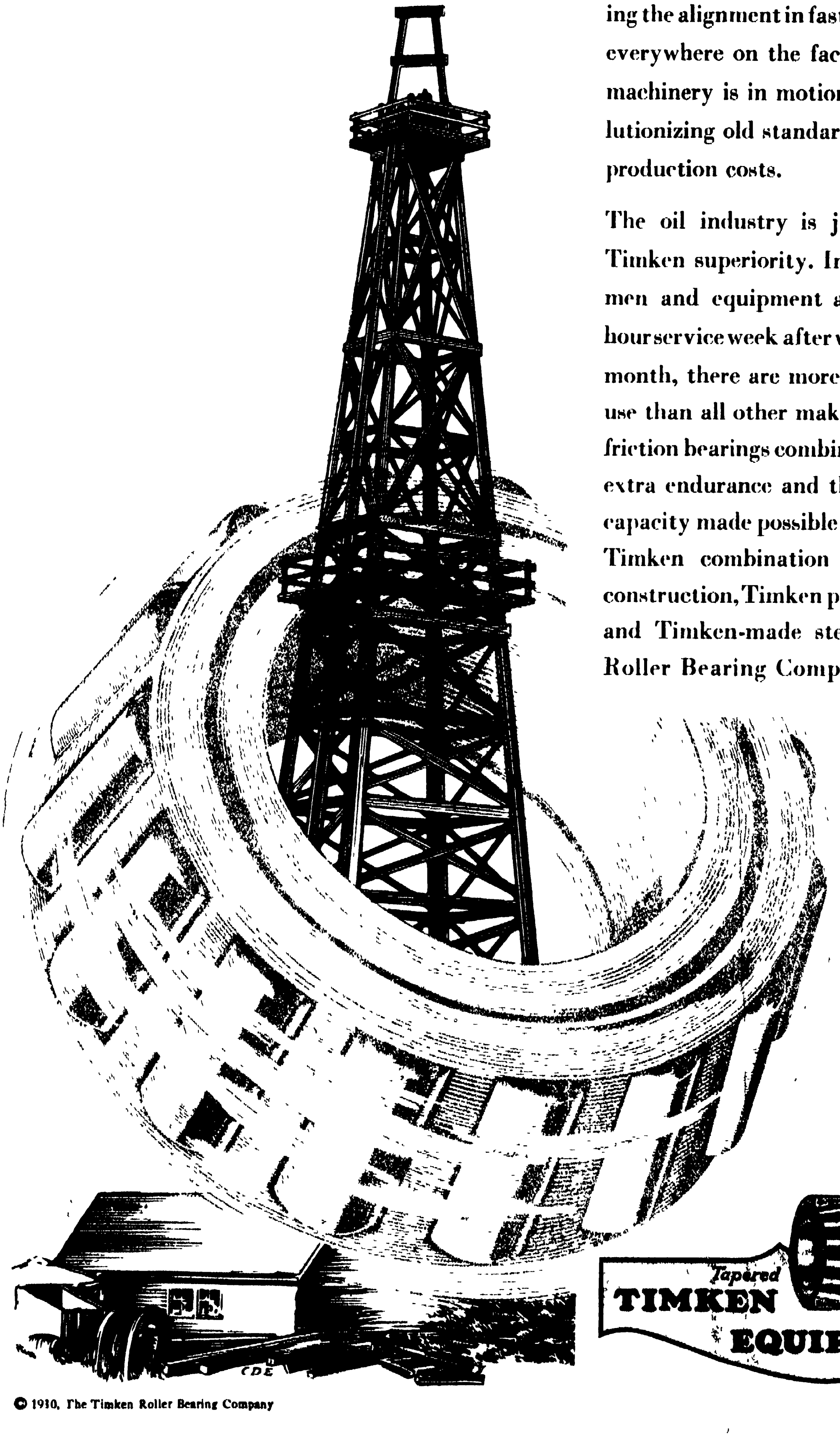

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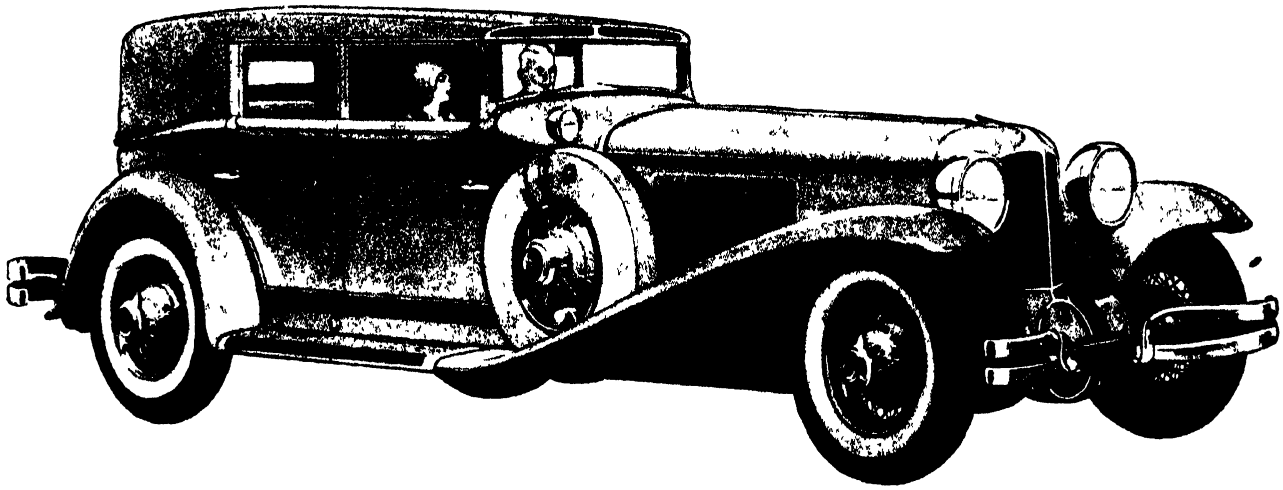

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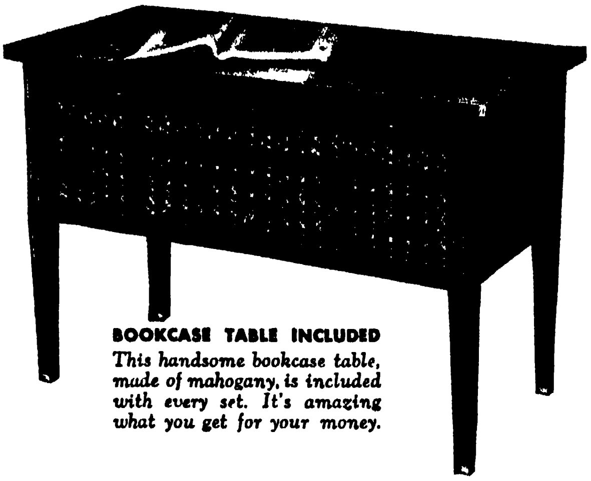

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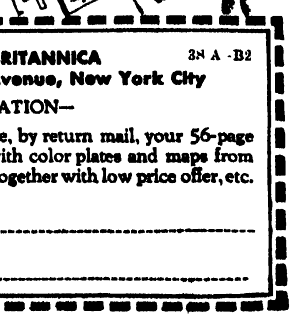

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SCIENTIFIC AMERICAN

ORSON D. MUNN, *Editor*

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EIGHTY-SIXTH YEAR

NOVEMBER · 1930

THIS MONTH'S COVER

Over Sydney Harbor, Australia, there is being completed a bridge that will be the largest of the arch type in the world. Its single span is 1650 feet long and its over-all length, including approaches, is 3770 feet. A deck 160 feet wide will be carried at a height of 170 feet above the water. Our artist, Howard V. Brown, has artistically illustrated this month a recent stage of the construction work on this bridge which, when completed, will have cost about 40,000,000 dollars.

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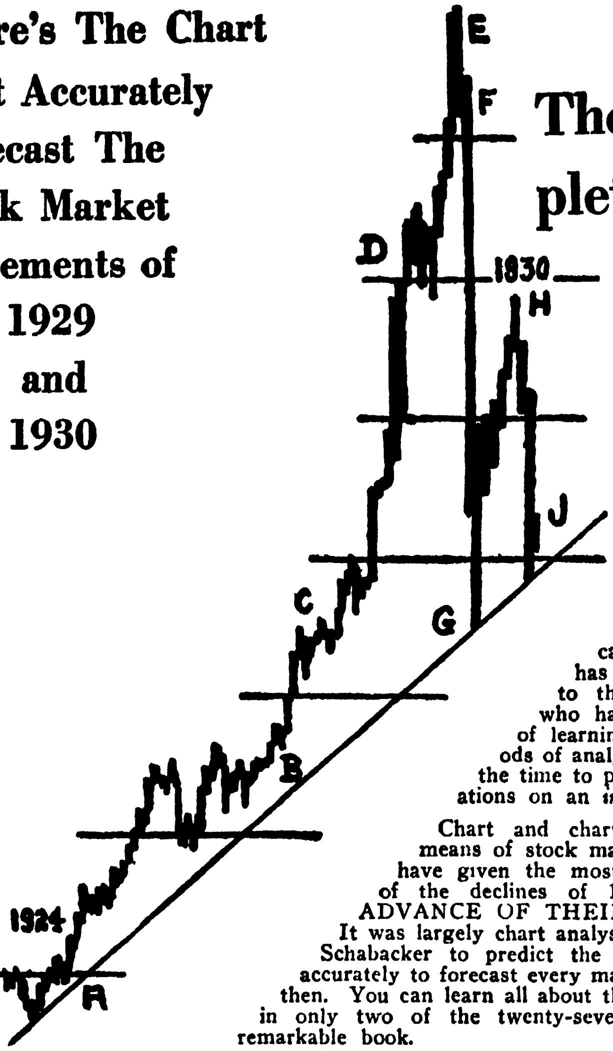
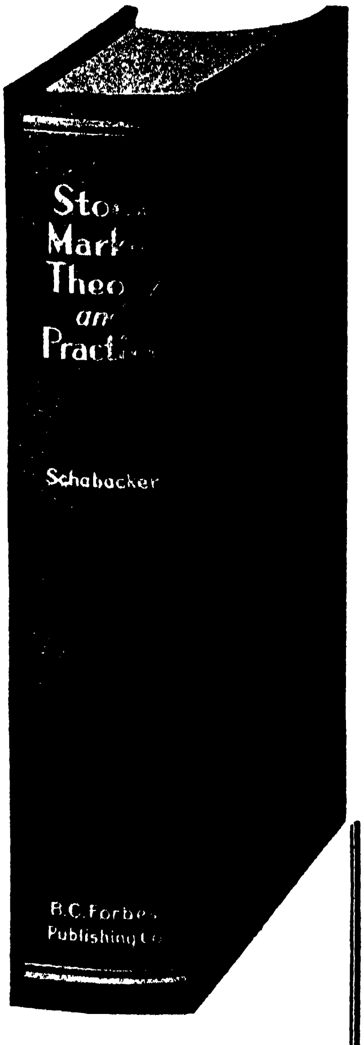
Here's The Chart That Accurately Forecast The Stock Market Movements of 1929 and 1930

The Newest and Most Complete Book Ever Published on the Stock Market!



THE chart reproduced herewith has told its forecasting story. But it has told that story *only* to the market operator who has made a business of learning up-to-date methods of analysis—who has taken the time to put his market operations on an *intelligent* basis.

Chart and chart theories are the means of stock market analysis which have given the most definite indication of the declines of 1929 and 1930 IN ADVANCE OF THEIR OCCURRENCE. It was largely chart analysis which led R. W. Schabacker to predict the Panic of 1929 and accurately to forecast every major movement since then. You can learn all about these chart principles in only two of the twenty-seven chapters in this remarkable book.



STOCK MARKET THEORY and PRACTICE

By R. W. Schabacker

Financial Editor of Forbes Magazine

In its wealth of information "Stock Market Theory and Practice" covers brokers' statements, tips, Exchange machinery, rights, stock charts, short selling, margins, pool manipulation, corporation statements, options, brokers' loans, money rates, price-earning ratios, market analysis and every other point on the stock market that may puzzle you.

It contains a folder map of Wall Street, with key, the names and addresses of member firms on the Big Board, the Curb, and on the exchange of 15 other cities, ticker symbols of all Big Board issues, lists of inactives, a large table for calculating stock yields, bibliography of 100 other stock market books, a chart on American stock prices and interest rates monthly since 1926, and an index of British stock prices covering 233 years.

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IX. The Short Sale
X. Odd-Lot Dealing
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XII. Dealing with the Broker
XIII. Outside Stock Exchanges
XIV. Types of Corporate Security
XV. Dividends and Rights
XVI. An Introduction to Stock Analysis
XVII. Price and Yield in Stock Analysis
XVIII. Sources of Stock Information
XIX. What Makes the Market Move
XX. An Introduction to Trading
XXI. Principles of Trading
XXII. Taking the Worry Out of Stock Trading
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ACROSS THE EDITOR'S DESK

WE were chatting with the editor of another magazine the other day, as together we glanced through the advance page proofs of the feature articles in the present issue. "Why," he asked, "do you place so much stress on industrial subjects in the Scientific American?" "Because," we replied, "industry today is the child of science. Without science, there could be none of the vast industries that are scattered throughout the world. Men of science, in both the pure and applied branches, are constantly bringing to light new facts that make possible new industries and bring about radical improvements in the old ones. Therefore, we keep our finger on the pulse of industry and report its progress, hand-in-hand with science."

And in our answer to the friendly question will be found the why and wherefore of our annual Industrial Number which you have before you. On the surface, the layman may not see the closely woven connection between science and industry. But when he is taken behind the scenes and is shown how industry profits rapidly by the advantages offered by scientific research, he begins to realize the parentage of our so-called Machine Age, and therefore ordinary factors in our daily life take on a new interest.

One of the most significant articles in this issue deals with natural gas, a fuel that is coming into wide use in both industry and the home. Here is a subject that proves most aptly the point which we made above. Natural gas has been known for centuries, but only recently has it started to climb to a real position of importance in affairs of the world. And science is the factor that has provided the basis for this climb, by making transportation of the gas commercially practicable.

Waste, the bug-a-boo of many industries and businesses, is rapidly succumbing to the advance of research. Many manufacturing plants are finding that waste material which was formerly going up in smoke or down to the city sewer can be reclaimed and turned to profit. Science and industry again. Several phases of this work are described on pages 378 and 379.

The business of making motion pictures grew from infancy to a flourishing adolescence within the space of a generation. Then came a period of partial stagnation. For years, inventors had been working on methods to give a voice to the silent pictures, and at a critical point in that period of stagnation, synchronous recording of pictures and sound stepped from the laboratory and revived the entire movie industry. Today the talkie has largely replaced the silent motion picture, but it still has its defects. These are dealt with, and suggestions for improvements made, on another page.

As these pages go to press, we are starting to work on some of the articles which will appear in the December issue. Prominent among them will be one on another phase of Scientific Criminology, by Stanley F. Gorman of the New York Police College, whose first article on this subject, in the October number, aroused so much favorable comment. In the coming dissertation, Mr. Gorman conducts the reader through the ramifications of a murder inquiry, and clears up many erroneous impressions that the public has regarding police routine.

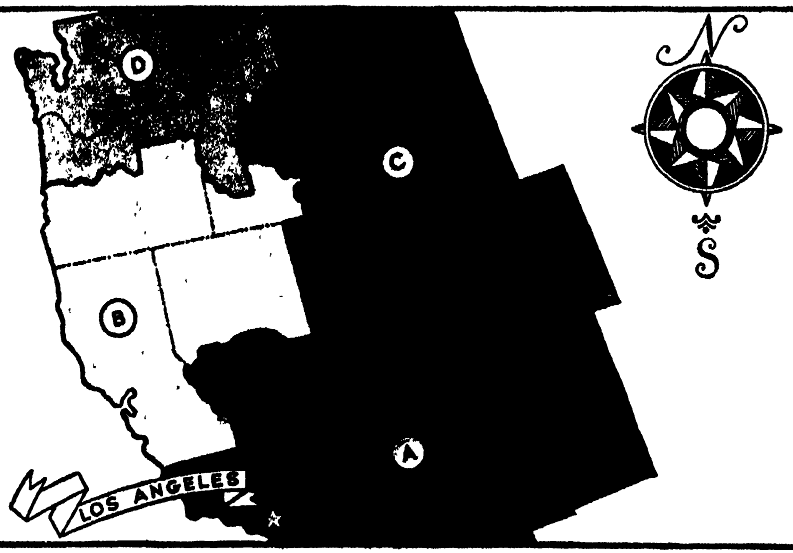
"Blind" flying may seem to be in the class of useless "stunt" flying until the layman realizes that the underlying purpose of instruction in this work is really to prepare the pilot to meet adverse conditions of visibility that are likely to be encountered at any time, even during short pleasure flights. The development of highly accurate instruments which tell the pilot all he needs to know, without the necessity of actually seeing the ground, has made possible rapid strides in safety in flight. "Blind" flying will be dealt with in a comprehensive manner in an article now ready for release.

If you are a manufacturer or inventor, you will not want to miss the descriptive article on a testing laboratory where the characteristics of anything from pins to refrigerators can be determined accurately for you. And if you are a consumer, you will be glad to see how your interests are protected in many cases by the exhaustive tests made in this modern "fault finding factory."

These are just a few of the high-lights that catch out attention as we go over the December schedule. Space is reserved for timely articles—spot news—that come up as the constantly changing panorama of progress unfolds. We also have ready for use articles on the new Raman effect in physics, crude oil, "What is a Quantum?" by Paul R. Heyl, the Mayas of British Honduras, X-ray "fingers" that reveal atomic structures, feeding the crew of a battleship, and other equally absorbing subjects.

Western Market

12 Million People



— served most economically from Los Angeles County

There is a distinct freight advantage in serving the Western Market of 12,000,000 population from Los Angeles County... its largest metropolitan center.

Zone A —Population 3,982,582... Local market immediately tributary to and including Los Angeles County.

Zone B —Population 3,002,753... Local market.

Zone C —Population 2,239,483... Parity in freight rates enjoyed by Los Angeles County.

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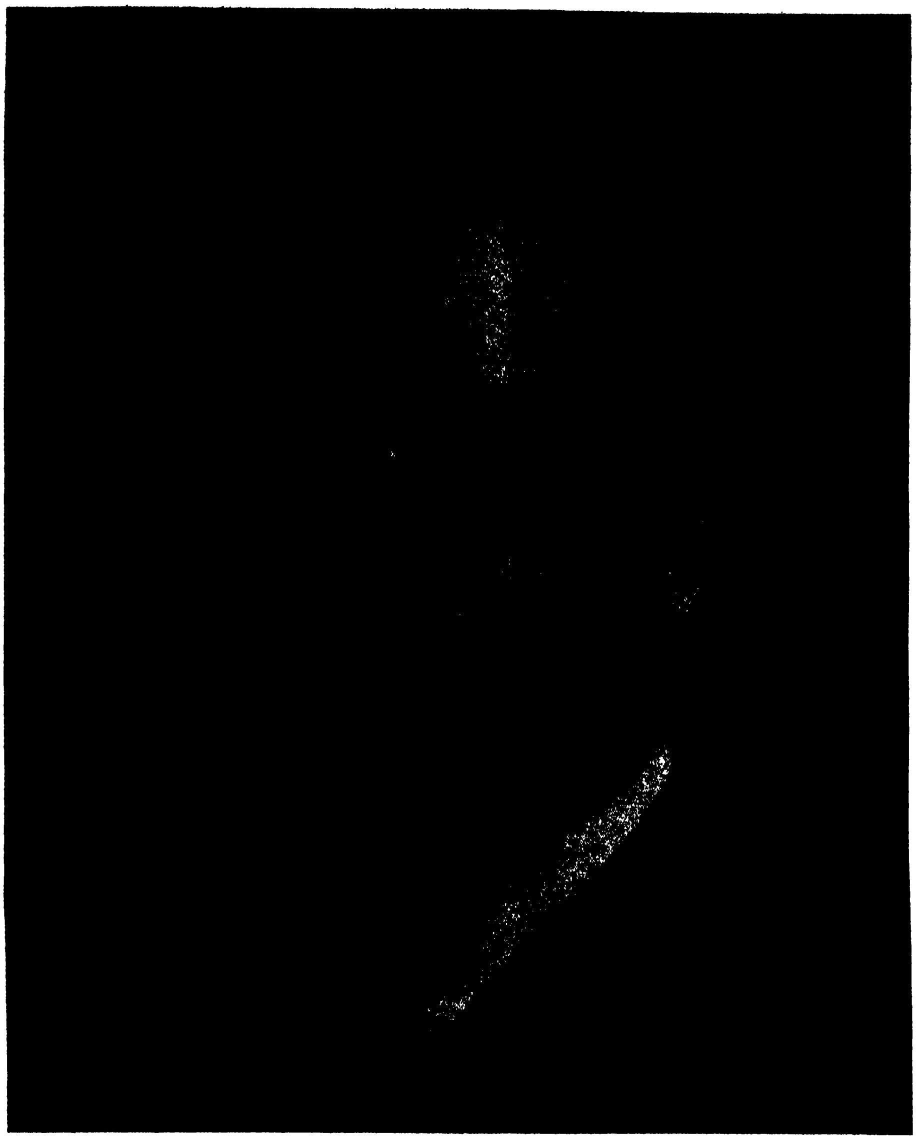
Industrial LOS ANGELES COUNTY

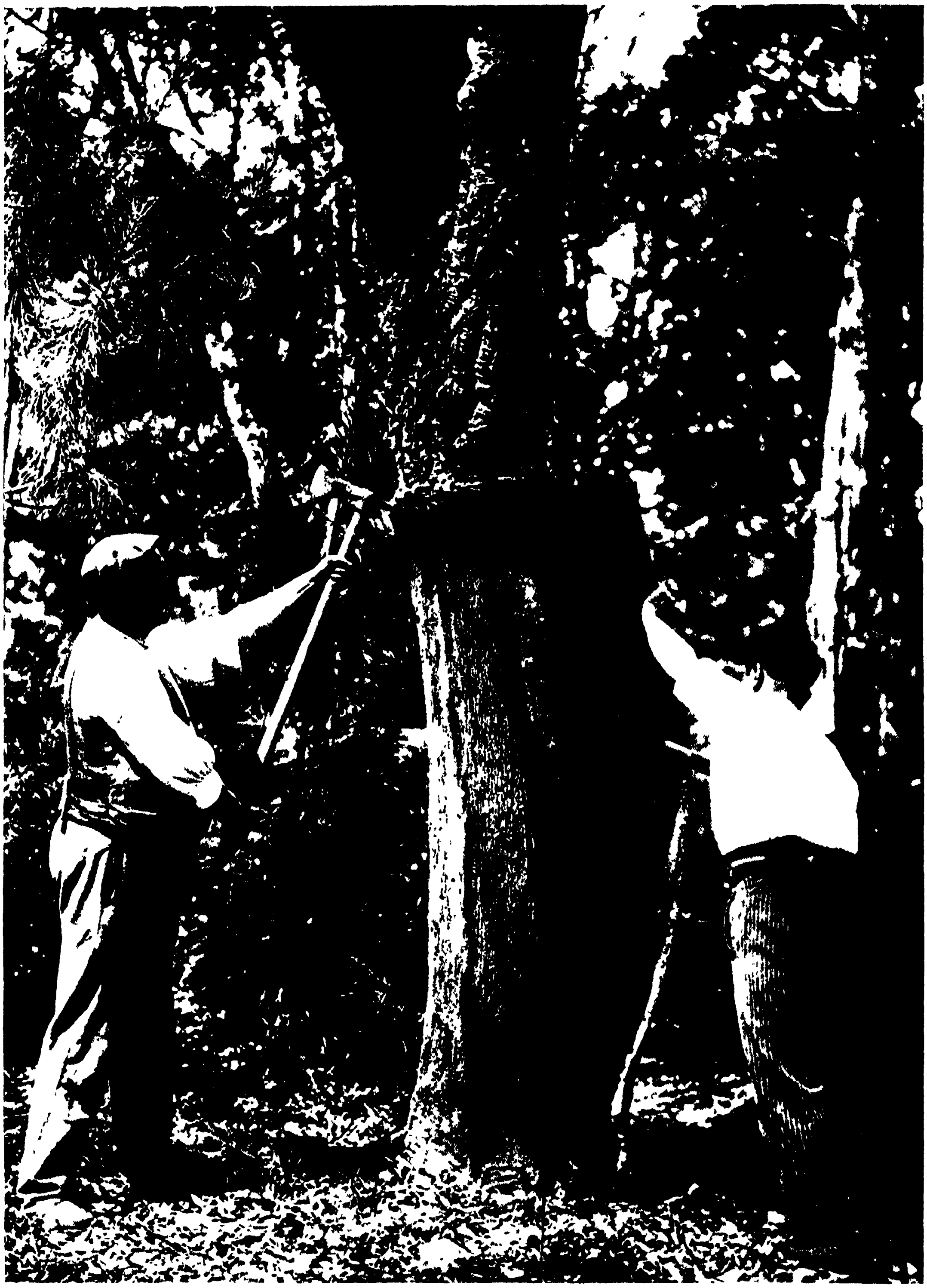
POPULATION 2,199,657

Manufacturing Executives Are Invited to Write to the Industrial Department, Los Angeles Chamber of Commerce, for Detailed Information Regarding this Great Western Market



ANDREW WELLS ROBERTSON

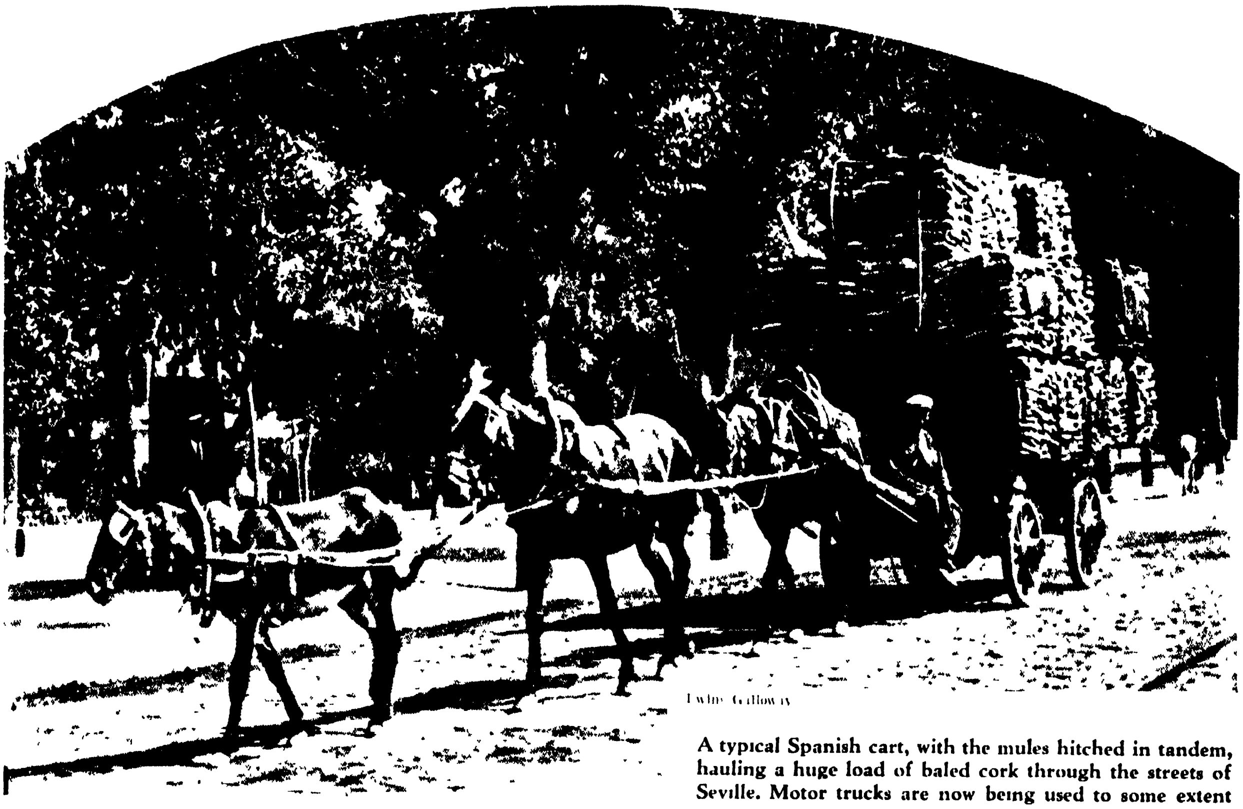
A HIGH SCHOOL principal whose vision saw beyond the confines of school walls and whose understanding of men, fairness, and canny Scot's industriousness have carried him to the high position of Chairman of the Board of the Westinghouse Electric and Manufacturing Company—that, in brief, is the biography of Mr. Robertson. Like many other leaders in American industry, Mr. Robertson's family background is modest. His father, a native of Scotland residing in Panama, New York, was a stonemason by trade. He died when young Andrew was but three years of age but this did not prevent Andrew from getting an education. He was graduated from Allegheny College in 1906 and was principal of a high school for a time. He studied law while conducting a private school for boys and was graduated from the University of Pittsburgh in 1910 with the degree of LL.B. Admitted to the bar, he joined a Pittsburgh law firm, practiced privately for a time, and later became trust officer for a large Pittsburgh firm and attorney for another. By 1918, he had become general attorney for the Philadelphia Company, was made vice-president in 1923, and president in 1926. In 1929, he attained his present position with the Westinghouse company. He is a trustee of his two alma maters, a director of many large corporations and associations, and a member of New York and Pittsburgh clubs. Being an able speaker, he is much in demand on public occasions but has never been attracted to politics—he has been too busy for that.



Ewing Galloway

THE CORK OAK GIVES UP ITS VALUABLE OUTER BARK

THE cork tree is stripped, always during the summer, at intervals of about eight or nine years. After the stripping, the tender inner bark is, of course, exposed for some time until a new layer of cork begins to form. For this reason, the stripping is never done when a sirocco is raging, for the heat of the wind would cause undue drying. In the illustration, an expert cork harvester is shown cutting the bark at the legal height—this must be done very carefully so that no injury is suffered by the inner bark—and his helper is prying off the bark with the handle of his axe. In some localities, the larger limbs are also stripped, but this is not the general rule.



Ewing Galloway

A typical Spanish cart, with the mules hitched in tandem, hauling a huge load of baled cork through the streets of Seville. Motor trucks are now being used to some extent

THE TREE BARK OF A HUNDRED USES

By BURTON DAVIS

WHEN the dry sirocco sweeps up off the Mediterranean and blows its hot breath on the Latin lands that border it to the north, there is one tree that remains gayly green. When the simoons twist north from the parched sands of the Sahara and whirl across Algeria, Tunis, and Morocco, one evergreen oak flourishes. That tree is protected by nature with a thick layer of the finest natural insulation in the world: you know it as cork.

All woody plants have a coating of cork, but this one sort of oak has more than any other. Certain elms and birches elsewhere in the world have outer bark that resembles it, but theirs is comparatively useless to man. The outer bark of *Quercus suber* and its almost identical cousin, *Quercus occidentalis*, known as the cork oaks, is in many ways unique in nature and invaluable in human industry. Nothing natural nor artificial has yet been produced to compare with it, for the *Quercus* bark has seven properties: resistance to the passage of moisture and liquids, buoyancy and light weight, resilience and compressibility, ability to absorb sound and vibration, strong resistance to progressive deterioration, low conductivity of heat, and an uncommonly high coefficient of friction

Through at least 2300 years, these properties have successively been discovered and utilized by man. Yet, although cork now has more than 150 distinct uses in the complicated apparatus of civilization, little is known about the physiological, physical, and chemical properties of the odd material.

ALL the literature on the subject of cork, including reports of previous research, could be carried in a small brief case. The men who have handled cork throughout the ages never bothered to find out much about it. A dozen chemists and botanists had worked on the problem of explaining how it grew and of what it was made up, but from 1787 to about 1927, had chiefly developed theories that were later discarded.

There was no accurate information on the number of cork trees in the world and how much cork bark they could supply. Man was using a natural resource and might reach the limit of its supply. Reforestation of cork oak had been largely left to nature and rare private enterprise Culture of the cork oak was not fully understood. All this had to be studied so that provisions could be made against the future.

And that was what the American cork manufacturers set out to do less than a year ago. Since then another factor has loomed up. Apparently we are about to enter another ice age, this time in food distribution, for huge plants are being built for the quick freezing of meats, fish, vegetables, and fruits to be retailed in packaged form, hard frozen, and kept at sub-zero temperatures. Such low temperatures in freezing plants, refrigerator cars and trucks, storage cases, and household iceboxes will demand cork-board in huge quantities.

Cork, therefore, has rather suddenly become an object of keen industrial interest. The factories called in the research doctors and set them to work to find out how cork is put together, of what substances, and, in exhaustive detail, what its physical and chemical properties and peculiarities are beyond the known and obvious ones. Cork was such a mystery that there was no predicting what they might uncover. To develop a satisfactory substitute for cork is one of the things the scientists hope to do, although at present that

Underwood & Underwood

Cork oaks partially stripped of their valuable bark in a scattered grove at Almorasma, Spain

seems to be a hopeless, impossible task.

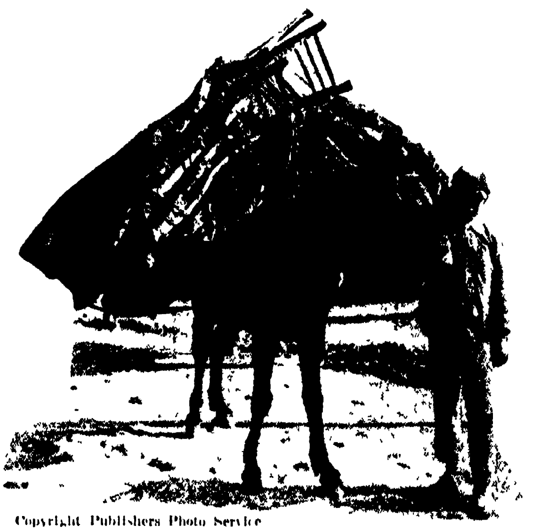
In the research and testing laboratories of a large cork company at Lancaster, Pennsylvania, only lately a photomicrographer took the first picture of the individual cork cell. The research, by scientists attached to the company, that led up to the taking of this picture—as well as the picture itself which is reproduced on page 347—showed that the cell has the geometric form known as tetrakaidecahedral.

This difficult word is from the Greek and means "having 14 faces." Lord Kelvin, years ago, found that units of 14 faces solved the problem of dividing all space, without interstices, into uniform bodies of minimal surface. In 1928, Dr. Frederic T. Lewis, of the Harvard Medical School, conducting independent research into cell structure, demonstrated that cork cells are tetrakaidecahedrons, each making contact with an average of 14 others.

EVEN though there are minute interstices between cork cells, these are filled with resin that is impervious to water and most liquids. Obviously a substance, the cells of which fit so snugly, is going to baffle the passage of any fluid which is unable to eat its way through. Thus the word for cork is the word for stopper, also, in most languages—a "stopper" is a "cork."

The first of the seven properties of cork, then, made the stopping of wine and oil jars one of its first uses. Horatius Quintus Flaccus (Horace) spoke of that in Ode III, 2000 years ago. Earlier than that, doubtless, the ancients had used the second property: buoyancy and light weight. Pausanias (not the Spartan admiral, but the traveler and geographer of the 2nd Century, A.D.) recorded that cork bark was used for anchor boards and on fish nets. Since each cork cell is more than half filled with air, the mass is buoyant. Its specific gravity is between .15 and .20, making it one of the lightest of solid substances.

The cell walls of cork are of tough, highly elastic material—much more so even than rubber—hence its resilience and compressibility. At Lancaster a one-inch cube of natural cork was recently put under pressure of 14,000 pounds to the square inch. The sidewise spread under that load was only a quarter of an inch. Released, the cork in a few hours regained between 90 and 95 percent of its original height, while the horizontal edges of the cube returned to exactly one inch. The secret of cork's unique behavior appears to be that only the air in the cells is compressed, hence the lack of side spread and the unequalled regain. Corks jammed in champagne bottles for 10 years will regain three-quarters of their original volume shortly after being withdrawn from the bottle.



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Sure-footed burros, top-heavy with huge loads, transport cork in the mountainous sections

Since dead air, in finely divided spaces, is, next to a vacuum, the best insulator known and the poorest conductor of sound and vibration, the fourth and sixth properties of cork are easily explained.

What will keep out heat will, in the popular phrase, "keep out cold"—which means it will keep heat *in*. Hence the use of cork-board insulation, which threatens to outstrip every other use of the cork in a few years, not only to insulate refrigeration units but also to insulate buildings against the winter's cold and the summer's heat. That last-mentioned use may have been the first to which cork bark was put, for the peasants all over the cork oak country still roof and wall their huts with slabs of the crude cork.

THE known chemical inertness—except to a few acids and strong alkalies—of the walls of the cork cell and the intervening resin explains cork's uncommon resistance to deterioration.

The fourth and seventh properties in the list have been the last to be utilized. Cork has only lately come into general use to absorb sound and act as a corrector of acoustics in echo-haunted halls and rooms. The first use in this respect was of cork tile as flooring for libraries and hospital halls. Now whole auditoriums are lined with a fine-grained cork-board. Radio broadcasting and sound film studios are using cork to exclude exterior noises, reduce interior sound and vibration, and break up echoes. Lastly, cork, long applied to reduce vibration and clatter in machinery of a hundred kinds, is now being used in slab form to insulate machines, from light fans to enormous engines and dynamos, against the transmission of vibration and noise.

The seventh property of cork—its high coefficient of friction—has been put to use only since the machine age came in. When cork bark is sliced cleanly, a surface is created exposing tens of thousands of hexagonal open cells to the square inch, each acting as a tiny vacuum cup. This, and the unusual resistance of the cell wall to frictional wear, gives cork the gripping and polishing properties now widely utilized. Plate glass mirrors and windows, fine glass and crystal, and optical lenses are polished on cork wheels. Leather and rubber both wear slick in short order, for their cell material has little of the toughness of cork's mysterious material, called "suber," which is neither cellulose nor wood fiber.

In the Lancaster testing rooms, one-inch squares of cork, belting leather, and rubber, all designed for the same use, were equally weighted and placed on an inclined plane. When the plane was inclined 18 degrees from the horizontal the leather slid down. At 28 degrees the rubber went coasting. Not until the plane was slanting 42 degrees did the cork creep down.

THE temptation in discussing the seven properties of cork is to wander off into fascinating bypaths to tell of the applications of cork that derive from these seven traits. They range from the tiny pieces in the pincers of pince-nez eyeglasses to the acres of cork-board, up to 12 inches in built-up thickness, in the walls of the quick-freezing meat packing plant of 1930; from the cork-lined cap of the tooth-paste tube to the newest and most uncommon use of cork in a planetarium. The first of these in America, recently completed in Grant Park, Chicago, has 9450 square feet of cork-board insulation on the dome.

The story of how and where cork grows, how it is gathered, prepared, transported, manufactured, and used, can only be sketched, for a full description of these fascinating phases would overflow this issue.

With a cork oak acreage of 550,000, Portugal leads the world with a production of 80,000 metric tons of cork; Spain is second with a production of 75,000 metric tons from 637,500 acres; Algeria is third with a production of 27,000 metric tons; while France, Tunisia, Italy, and Morocco come next in order; and even Japan produces about 400 tons of inferior cork yearly.

When part of a grove of cork trees has attained an age of about 20 years—for the first cutting—the expert cutters, each helped by apprentices, start to work. The expert makes a careful cut, with a tomahawk-shaped hatchet, around the trunk just above the exposed roots—in Algeria he may use a circular saw—and another just under the lowermost branches. These he connects with two vertical cuts, following the biggest natural cracks. The assistants help him pry off the bark. All this is done with the finesse of a surgeon, for any injury to the inner bark, or *phellogen*, which builds up the cork, results in a scar area over which no new cork will ever grow. This first cutting of bark, called "virgin" in Spain and "male cork" in France, will sell for a low price, to be used in the rough for florists' baskets, arbors, ferneries, and to be ground into low-grade granulated cork.

Nine or ten years later, the cutters will be back in that same grove, removing the new growth of cork, of finer grain and in every way more valuable. In some places they will also strip the bigger parts of the chief branches; in others, restrained by law or local regulation, they will wait for about five years, strip the large branches, and four years later denude the trunk again. In the French government forests—about half of those in Algeria and Tunisia—stripping the branches is prohibited. In some private forests of Spain the cutters may go back after eight years. In Portugal the law demands a wait of nine years, and the first crop cannot be removed until the tree is 15½ inches around, three feet above ground. Each crop after the first is progressively better until the tree is about 40 years old. Thereafter it may be expected to continue to produce fine cork until it dies, at from 100 to 150 years.

Right: Photomicrograph of the cork cell. Six cells are shown touching the central one at the point of cleavage

Underwood & Underwood

After the cork has been cured and dried flat, it is trimmed and packed in bales for shipment

Virgin cork is bought with no particular care, on a weight basis. But from the second stripping on, the value of the cork makes buying a careful balance between buyer's and seller's ideas of its worth. The cork buyer is an important personage, for on his judgment profits are made or lost. He migrates with the cork cutting season, penetrates all manner of country and deals with all manner of cork grove owners, cutting contractors, and government officials.

Arrived at a certain stand of cork, in advance of the cutting season—April to June in North Africa, July and August in Europe—the buyer sends his sampler through the grove on a beeline. With a cylindrical punch, the sampler cuts out a disk of cork from every 5th, 10th, or 20th tree and jumbles these in the huge sack on his back. At the buyer's office these are scrutinized with care, for on the average of them the buyer will base his bidding for so many tons of cork, perhaps for the stripping from a whole mountainside. In the French gov-

Copyright Underwood & Underwood

Great stacks of the cork as it comes from the trees. In foreground, a bale ready to be shipped ernment forests of north Africa, however, the cork is gathered at stations to be sold at auctions.

To return to the typical scene, say in Spain or Portugal: The stripped cork bark is piled up in the grove and left a few days to dry. Then it is weighed on a "romana," a type of yard scale introduced by the Romans 2000 years ago. (Cork harvesting methods have changed little in 20 centuries.) The bark is carried on burro back or in carts to the boiling station at the edge of the forest nearest the market or the railroad line.

Boiling the curved slabs in large vats fired with dead corkwood softens the bark so that the rough, creviced, outer layer can be scraped off by hand with a flat tool. This process removes about 15 percent of the weight of the slab, removes the tannic acid from the cork, increases the volume and elasticity, and makes it possible to dry the slab flat. After being roughly sorted for quality and thickness, the dried bark is loaded on sturdy burros, which pick their way carefully down the mountain trails to the railway station, topheavy with a huge pile of the light bark aboard, bigger than the animal himself. As roads in Spain and Portugal are improved, motor trucks are replacing the picturesque burro.

Ewing Galloway

Underwood & Underwood

The cork industry in southern France is the same as it is across the border in Spain. Above is shown a girl operating a cork cutting machine that reduces strips into cubes which are later cut into bottle stoppers. At the right a girl is operating by hand a machine that cuts the stoppers from the cubes

ARRIVED at the warehouse and manufacturing center the crude bundles are opened and the rough edges trimmed off the slabs. Another grading for quality takes place, dividing the cork into about 25 classes. The bark for export is baled in a hand or a hydraulic press, bound tightly with iron straps, and stenciled. The bale is then ready to be loaded into the hold or on the deck of a steamer. Philadelphia, New York, or Baltimore will be the destination of nearly all of the exported crop; the rest will have gone to the stopper cutting shops nearby, the trimmings and "waste" from which will also be baled for export to the cork composition or linoleum factories overseas.

One manufacturing company has its own receiving plant at Gloucester, New Jersey, just below Philadelphia, where the various grades are separated and sent to various plants. At Pittsburgh, where the finer grades are made into bottle stoppers and other natural cork products, the final sorting puts the bark into as many as 80 bins, the grades differing so little that only the expert can detect the difference.

At this point the story of cork divides into four stems: the business of making bottle stoppers and natural cork products; the distinct processes used to make cork composition products out of scrap and grinding grades; the process carried on elsewhere which turns out cork-board for insulation, machinery isolation, and corkoustic; and the complex business of making linoleum, linotile, and other flooring material.

The key to this maze is the utilization of waste. Automatic machines punch bottle stoppers out of the best of the bark. The punched-out strips are ground into flour for linoleum or granulated for making cork composition. The coarser cork is ground into larger granules to be pressed, at high temperature, into cork-board slabs, the natural resin forming the only binder used.

Natural cork is used for pistons for plunger fountain pens and for wind musical instruments; seine and gill corks for fishing nets, and bung corks and artillery practice wads. From natural cork are also made disks for bottle crowns and patent caps, bulletin boards, penholder grips, cork balls for games, plasterers' floats, and many other products.

CORK composition is used for box toes, counters, insoles, heel lifts and pads, and bottom filler in shoes; also, in all manner of gaskets to stop leakage of gasoline, oil, or water; in churn strips, bobbers or floats for fishing lines, and so on.

In the automobile, cork and cork composition may be used in as many as 50 places, most of them unsuspected by the owner.

Linoleum is made from cork flour, as described in the October issue of Scientific American. Linotile, a tile of linoleum composition, is laid in special patterns by hand and produces marble and tile effects. Cork brick, non-skid, almost impervious and resistant to acids, is used in dairy barns and modern pigsties for better sanitation.

Cork carpet, made of coarser cork, is used particularly in public buildings where sound deadening is important.

Granulated and regranulated cork is used for packing fine china and glass, grapes, and other fruits. Despite modern industrial advances, cork holds its own as one of the most useful of natural substances, although it is still one of the most mysterious after 2300 years of use; in fact, it is playing an increasingly larger rôle in the drama of industrial progress.

OUR POINT OF VIEW

ACROSS THE ATLANTIC

NO transatlantic flight or attempt to make an airplane crossing of this stormy ocean since the unsurpassed flight of Colonel Lindbergh, in May, 1927, has so fired the imagination of the world as the three successful westward flights this summer. A Briton and a German made the first two flights, each with one or more stops, and the climax came when a Frenchman, already famous and a hero among his people, made a non-stop flight from Paris to New York in a plane that was also already famous for its share in his exploits.

In June, Wing-Commander Charles Kingsford-Smith, with E. Van Dyk, Captain J. Patrick Saul, and J. W. Stannage, flew from Ireland to Roosevelt Field, Long Island, in the *Southern Cross*, making one stop in Newfoundland. His flight marked the completion of a spectacular 'round-the-world air trip which had started over a year previously. In August, Captain Wolfgang von Gronau, with Edward Zimmer, Franz Hack, and Fritz Albrecht, made an unheralded flight from Germany to New York Harbor, with stops at the Faroe Islands, Iceland, Greenland, and Nova Scotia. His flight was praiseworthy for two reasons: first, because in this day of blatant exploitation of air feats, his was a surprise trip, few knew anything of it until it was over, and, so far as we know, he has not commercialized it; and secondly, because his route may prove the most feasible when transatlantic airplane services are inaugurated.

When Dieudonné Coste and his co-pilot, Maurice Bellonte, landed the red *Question Mark* at Curtiss Field on September 2, the final chapter in the long and tragic story of the conquering of the stormy north Atlantic by airplane was written. They had taken off from Paris 37 hours 18½ minutes previously. To these two daring fliers go, therefore, the laurels for the first non-stop crossing of the north Atlantic by airplane from the continent of Europe to the United States. They have accomplished what many others before them had tried and what they had unsuccessfully attempted in 1929.

Aviation owes much to these pioneers of 1930. When and if airplane service is started across the Atlantic to and from the United States, the lessons learned by their flights will have much influence in the choice of routes, modes of operation, and so forth. But we consider that the pioneering has now been completed except in cases where totally different types of planes—such as the Dornier *DO-X*—may be involved, and will frown upon any further individual attempts to conquer the Atlantic. Such transatlantic flights will seem to us to have the taint of commercialism or to be inspired by individual desire to exalt an already inflated ego.

GAS FROM THE EARTH

ON page 380 of this issue we publish the story of the amazing growth of an industry about which little is known: that which has been and is being built up around natural gas. Possessing about twice the heating value of artificial, or manufactured gas, this natural mixture from the earth's reservoirs has been used commercially for over 60 years but has only recently become an industry of huge proportions because of recent technical developments that have shown the way to discovery of large natural gas reserves and have made possible long distance pipe-lines.

During the current year, the natural gas industry has expanded at a greater rate than perhaps any other industry of importance—and that despite world-wide business depression. Its increase in pipe-line mileage from 80,000 to 90,000—including pipe-lines put into operation and also those on which construction has been started—represents an increased capacity of more than 12½ percent. *The Lamport Review* estimates that this 10,000-mile increase adds "at least 250 million dollars to capital investment" in the industry.

Truly this is the bright spot on the business horizon. It puts to shame many other industries that have not progressed this year—yes, despite the depression—and teaches a lesson of research and development, far-sighted belief in the future and rapid expansion. The confidence of the men behind it is worthy of the highest praise.

FUTURE AIRSHIPS

SHORTLY after the successful flight of the *R-100* from Cardington, England, to Montreal, Sir Dennistoun Burney, its designer, outlined a new proposal to establish a transatlantic airship service in which he attempted to prove that a company possessing four or six new ships twice the size of the *R-100* could operate with profit.

Such proposals are not new, but the fact that this one takes such definite form indicates that the time when a transatlantic airship service of some kind will be a commonplace thing draws rapidly nearer. In the face of this fact, American vision apparently does not see as far ahead as does Sir Dennistoun. We have under construction two airships that will be far larger than any heretofore built but beyond construction of these two we have no plans for the future—unless they be deep, dark secrets. And even for each of these two dirigibles, we are importing eight Maybach engines from Germany. This may have no very great significance but to us it is indicative of the passive interest of American engine manufacturers in the development of American airship engines.

One of the many criticisms of the dirigible is that it is bulky. True, but *The Engineer* (London) points out that its weight per passenger is only 1.56 tons as contrasted to nearly 21 tons per passenger of the liner *Mauretania*. Fuel consumption is not considered excessive; and transatlantic passenger and mail rates little in excess of steamer rates are to be expected.

But aside from all such arguments, the airship is with us and we believe it will stay, although no one can predict its ultimate status. Why, then, American apathy toward developing it to the fullest extent? Much experimental work is yet to be done but we should like, particularly, to see some intensive research done toward developing an American airship engine.

INTERNATIONAL AFFAIRS

Navy Day

October 27th. Theodore Roosevelt's birthday, is Navy Day, and at every Navy Yard and on every man-of-war the Navy personnel will be at home to the American people. All who can should take the opportunity to visit the nearest ship or station, to show their interest in the officers and men who are our first line of defense.

In time of war we lavish praise on our Navy; in time of peace we are too likely to forget it. We take the efficiency

(Please turn to page 409)

RADIO CHARTS THE UPPER AIR*

By JEROME D. VAN BRAKLE

SIGNAL CORPS engineers of the United States Army have devised a means by which radio can be used to determine air conditions several miles above the surface of the earth, and after more than seven years of experimentation they have perfected, at the Signal School laboratories at Fort Monmouth, New Jersey, equipment by which the direction and velocity of the winds at high altitudes may be computed with a high degree of accuracy regardless of visibility.

Visual observations of upper-wind conditions are impossible at night and when visibility is reduced by low-lying clouds or fog. Since many war operations are carried on behind smoke screens or after dark, it became necessary to devise a method of obtaining the desired upper-air information under these conditions for Army use. The radio method was the answer to the problem.

THE radio device, perfected at Fort Monmouth, consists of a miniature continuous-wave transmitter which is sent aloft by means of three hydrogen-filled balloons. Its flight is followed with a loop direction finder, a process known as "tracking" or making a "balloon sounding." Long research was necessary before an efficient direction finder was perfected, as it was found that the commercial instruments used in radio compass work were not sufficiently accurate for meteorological use.

The loop direction finder consists of a specially-built radio receiver of rugged construction connected to a loop antenna composed of a single tube of copper, mounted on a tripod base. To the shaft of the loop is connected a calibrated dial, graduated in degrees and fractions. This dial is used to measure the angles through which the loop turns. Except for the fact that the receiver is of the regenerative type, Signal Corps authorities refuse to divulge the details of its construction.

The transmitter which goes aloft with the balloons is compact and sturdy and weighs less than a pound. It consists of a small vacuum tube, an inductance coil of enameled wire, a small transformer, and a small flashlight battery, the whole outfit costing about five dollars. When the battery is snapped into place at the bottom of the device, continuous-wave oscillations are started which will continue for more than two hours. This wave has been picked up from a distance of 15 miles.

The length of wire which connects the transmitter to the balloon cluster acts as an antenna. Signals are sent at a constant frequency of 2300 kilocycles or 130.5 meters.

When the balloon cluster, carrying the transmitter, is liberated it ascends vertically, because of the hydrogen gas, but at the same time it is blown about by the winds it encounters. This lateral motion is recorded by observers and from the data obtained, the speed and direction of these winds may be accurately determined.

It has been found that the cluster will rise at the rate of approximately two hundred yards a minute and that this rate of ascension will continue until the internal pressure of the hydrogen gas exceeds the outer pressure of the rarefied atmosphere and one or more of the balloons burst. Usually only one bursts and then the others act as a

Signal Corps photographs

The direction finder receiving set and the balloons for carrying the radio transmitter, used in the newly developed method of determining upper air currents

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*Published by permission of Major General George S. Gibbs, Chief Signal Officer, United States Army.

parachute and gently lower the apparatus to earth with little damage.

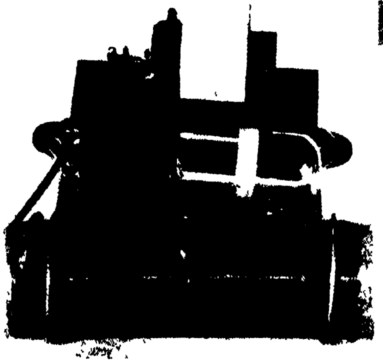
While the balloons are in flight, observations are taken by two direction finders set up on a base line of known length. Experiments have shown that this length should be three miles for the best results, although shorter distances have been used with a high degree of accuracy. Sometimes three instruments are used; then they are set up in the form of an equilateral triangle of known sides. The third instrument, however, is used principally as a check on the others.

AFTER the release of the balloons, operators obtain bearings on them every minute. Accurate time is given by a clockwork device which emits a howl at the end of each minute and a warning buzz ten seconds before the minute. The bearings are telephoned to an observer at a plotting board where they are entered on a scale map. The point of intersection of each set of two bearings shows the exact position of the transmitter at any minute. From these data it is simple to determine the horizontal flight of the apparatus and by means of a special protractor and a wind scale, the required velocity and direction of the wind at each level of altitude is computed. Balloons may thus be tracked for several miles.

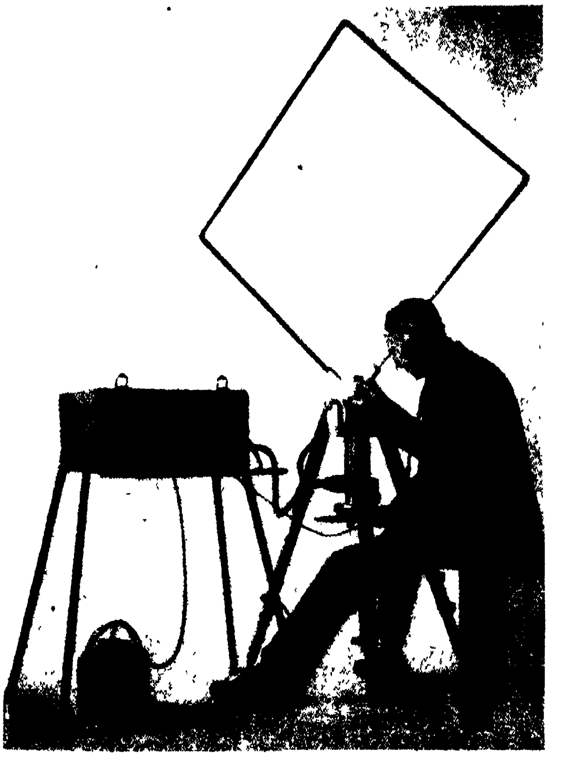
The observers at the loops base their calculations upon the zero point, where the signals from the transmitter are not heard. The loop is revolved until the signals disappear and the angle is read from the scale on the shaft of the loop. At the zero point, the plane of the antenna is at right angles to the direction of the transmitter. One of the points of high efficiency of the Army receiver is that the zero point does not vary until the transmitter is more than three miles from the receiver, then the variation is so small that accurate results may be obtained for seven miles and usable results for several miles further. Experiments have shown that the zero point in commercial sets splits before the transmitter is a mile away, greatly lowering the efficiency.

While the new system was undergoing preliminary tests at Fort Monmouth, simultaneous readings were made by radio and visual methods. These experiments showed that the radio method gives more accurate results as the continuous signal can be more easily traced. The visual method is more commonly used, however, because of the greater distance possible and because of the economic phase.

In the Atlantic seaboard states, where the prevailing winds are easterly, most of the instruments sent aloft are lost in the ocean, but in the Middle West, 95 percent of the transmitters are recovered. To insure the return of as many of the transmitters as possible, a notice is attached to the set offering a small reward to the finder if the instrument is sent back to the base station.



Above: **The one-pound short-wave transmitter attached to balloons.** ***Left:*** **A close-up of the transmitter. The battery is behind the instruments**



The direction-finder loop in use. The operator swings the frame, listens to the signals, and reads the angle

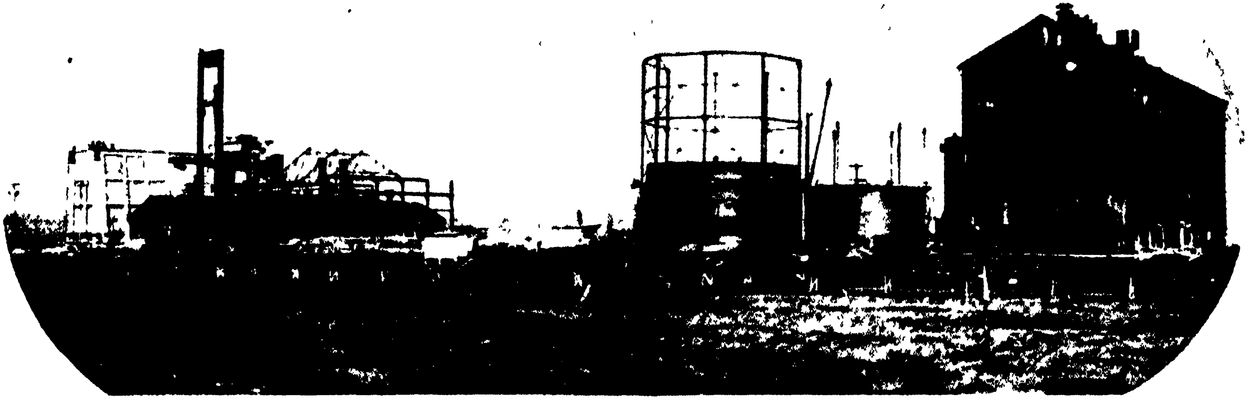
At Fort Monmouth, one day recently, a farmer drove up to the reservation in a dilapidated farm wagon. He walked up to the meteorological officer and handed him one of the transmitters which had fallen on his farm.

"You came mighty near not getting this contraption back," he declared. "When it came fluttering down in my cornfield I thought it was some new kind of bird and I almost wrecked it with my shotgun."

Although many of the instruments are returned in peace times, few recoveries would be expected in time of war. The cost of the apparatus in comparison with its utility and the value of the information it gives is so small that little thought would be given to the loss.

AT the present time, radio officers at Fort Monmouth Signal School are experimenting to find a method of determining upper-air temperatures by radio. A bi-metallic plate of variable capacity at different temperatures has been inserted in the circuit of the transmitter just described. It is designed so that the wavelength will vary as the air temperature increases or diminishes and these wavelength changes will be noted on the ground by means of suitable instruments.

Now that the common wind vane has been lifted high into the air by means of radio, it is the ultimate aim of these agents of Uncle Sam to use the radio device, with variations, to unfold many other secrets of the upper air currents.



Hydrogenation plant of the Standard Oil Company of New Jersey under construction at Bayway

A GALLON OF 'GAS' FROM A GALLON OF OIL

By HENRY W. HOUGH

"OIL DIPLOMACY" is the title of a long chapter in Ludwell Denny's arresting new book "America Conquers Britain" (Knopf), a remarkable record of economic war which is taking place today on a worldwide front in the form of bitter struggle between America and Britain for world markets in major commodities. The struggle takes its most violent form in oil. The most powerful world participants in the great contest are the vast Deterding interests (Shell) of Great Britain pitted against the Standard interests of America. The oil reserves of the smaller nations—Persia, Mexico, Colombia, Venezuela, and so on—are the rich fruits of battle. The accounts of some of the dealings between the rival giants make fascinating if somewhat grim reading; the international oil war is not a game of tiddleywinks. Ostensibly the oil war between America and Britain is conducted by private interests but Mr. Denny reveals that both governments have taken a hand. And why not? Oil is a national asset; without it no nation today can remain a first class power. Britain is not losing the oil war; we are. She has largely outwitted us, gaining control of the best resources. We are left holding the bag. "The public has been in no mood to champion the cause of any oil company at home or abroad," Mr. Denny writes, "but this sentiment is changing. The danger point will be reached when a near-shortage drives prices upward and American automobile owners are told the British have cornered most of the world supply." Britain is keeping much of her own oil supply intact and cleverly finding ways to exhaust ours. The Bergius processes, described in Mr. Hough's article, are German in origin and Standard has obtained them, but the cheapest oil at present comes from the ground. When the American people finally wake up about the oil situation will it be too late?—*The Editor.*

LAST season, or perhaps it was the preceding season, a thrilling drama was witnessed by theater-goers. It involved a young genius who had made a scientific discovery of startling significance. He proved that he possessed the power to blow the world to smithereens. His secret was known only to himself. Anxiety and apprehension resulted until the closing scene of the play.

Another drama almost equally exciting although somewhat less sinister now is being enacted before a much larger audience. The opening scene was in a laboratory in Germany, and centered about the research of the noted investigator, Dr. Friedrich Bergius. The scientific world was amazed by the news concerning his hydrogenation process for converting wood into coal, coal into oil and gasoline, and so on.

NOW the scene has shifted to America. About a year ago the rights to Dr. Bergius' process were acquired by the Standard Oil Company of New Jersey, in affiliation with the I. G. Farbenindustrie or "Dye Trust" of Germany. With the news of this merger, which followed three years of co-operative examination of the technical and commercial possibilities of the process, there came another startling announcement: "It now is commercially practicable to produce 100 gallons of gasoline from the running of 100 gallons of crude oil, by the addition of gaseous hydrogen under high pressure and high temperature in the presence of certain catalytic agents."

These developments have aroused rather than allayed the fears of those who anxiously await the outcome. Will the next scene show chaos in the petroleum industry? With over-production of oil constantly worrying the producers, must they now face a flood of cheaper "artificial" gasoline?

The petroleum industry has waited rather impatiently for further progress reports. The general public has exhibited similar interest, for today "the man in the street" is not only a consumer of gasoline and oil, but also is on the lookout for investments which seem to have great potentialities.

With the opening, a few months ago, of the first of three 5000-barrel-a-day hydrogenation plants, it seems that the Bergius process at last is ready to become an important factor in the petroleum industry. The first commercial plant is located at Bayway, New Jersey. Two others are to be built soon, one in Louisiana at Baton Rouge and another in Texas at Baytown. These plants are more than experiments, for each is a large-scale commercial unit based on the results of several years of intensive research and development. No effort has been spared to perfect the conversion apparatus and the methods of operation best suited for commercial production of gasoline and light oils.

To the layman, who may have grown weary of hearing about over-production in the oil industry, it may seem that hydrogenation has been born too soon. Even in the face of solemn warnings that the world's supply of petroleum

The retorts (inside the concrete structure) in which the hydrogenation takes place at Bayway

can last only a few more generations, there are many who feel that at present there is no place for any revolutionary method of producing motor fuels. However, the situation takes on a different aspect when one is familiar with the other great developments which have led up to the present state of affairs.

When the oil industry was very young, there was a well-distributed demand for all of the important products of petroleum. Then the market for illuminating oil stepped ahead of the others. While meeting the demand for kerosene, the refiners found that something had to be done about disposing of the rest of the products.

The solution was found in a new process, by "cracking" the heavier fractions of the crude oils in such a way that a larger proportion of kerosene was obtained. Crude oils which normally yielded 20 to 30 percent of kerosene were made to yield from 50 to 70 percent by this revolutionary step.

SOME time later, the situation took a new turn. Gasoline became the most valuable fraction, and the demand for kerosene declined. Again something had to be done about utilizing the less valuable products, and again the solution was found in improving the process. It proved to be considerably more difficult to increase the gasoline yield, but the result was nearly as good as when effecting the decomposition into kerosene fractions. At the present time about one third of the world's total demand for gasoline is met by "cracking" or conversion, rather than by refining.

With this background, it is easy to see where hydrogenation fits into the picture. With the ever-growing demand for gasoline and light oils, there has been constant over-production of the less valuable products, the heavy oils. The market has shown that it does little good to lower the price of this class of fuel. There simply is little demand for it.

Careful examination of the cracking process does not give any grounds for presuming that the problem can be met by an improvement in technique with the present production methods. Attempts are being made to perfect the Diesel engine to so great an extent that it will operate satisfactorily on the inferior grades of fuel oil, as it now does on the better grades. Research in both of these fields is yielding some very commendable progress, but there seems to be no justification for high hopes. Meanwhile, the world has an enormous over-supply of heavy fuel, and the market for the more valuable motor fuels has not yet neared the limit of its elasticity.

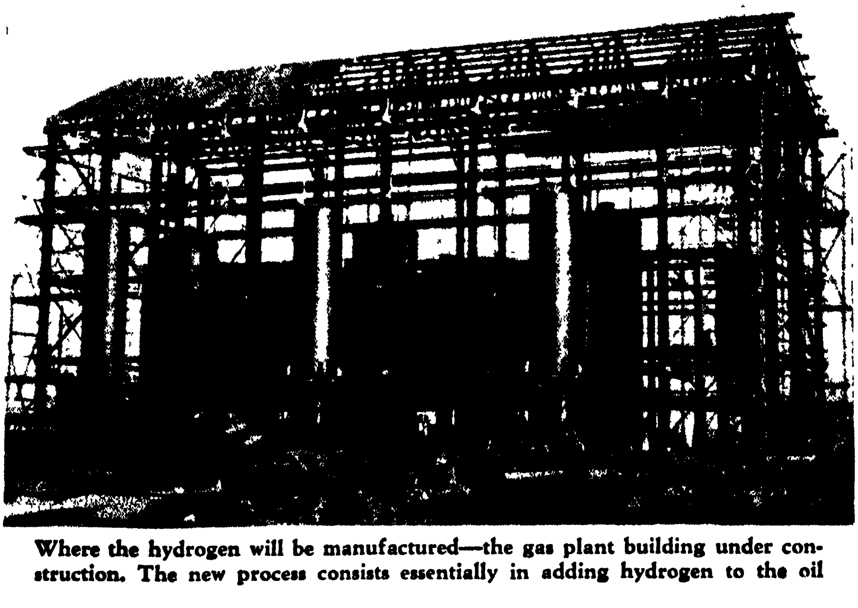
From this it is clear that there is need for a new manufacturing process which can make profitable use of the petroleum products which now are a drug on the market. The hydrogenation process, in its present state of development, is more than capable of meeting this need. This process has shown its ability to do greater things than convert heavy oils into gasoline.

Dr. Bergius took several steps at once when he worked out a method for converting wood into gasoline. First he duplicated nature's "incoaling" process, by which he quickly transformed wood or other vegetable matter into coal. Then he went on with the same process, converting the artificial coal into oil. It was found that the same thing could be done with natural bituminous coal. The hydrogenation of heavy oils into gasoline and light oils is but a page in the story of Dr. Bergius' achievements.

After enumerating that remarkable series of advances, the writer scarcely dares mention Dr. Bergius' one great purpose, an unfinished performance which may yet make these others seem like mere side-shows. Underlying all of his research is the greatest objective of all—to perfect a practical process which will enable man to make his own food, and food for his animals, by utilizing apparently worthless materials which now are burned as rubbish.

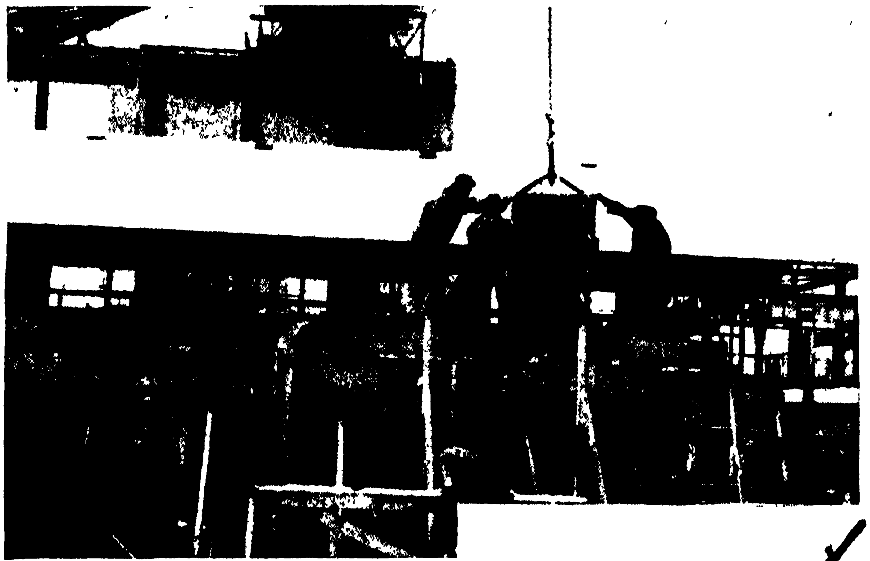
RETURNING to today, after this glimpse of the day-after-tomorrow, we can look more deeply into the process which now is being used to produce gasoline from almost worthless heavy oils. Of paramount importance in this conversion process are the toxin-proof catalysts. These make it possible for the gaseous hydrogen, which is introduced into the high-temperature conversion apparatus under exceedingly high pressures, to transform the molecules of the heavy oils into molecules of gasoline and other light fractions.

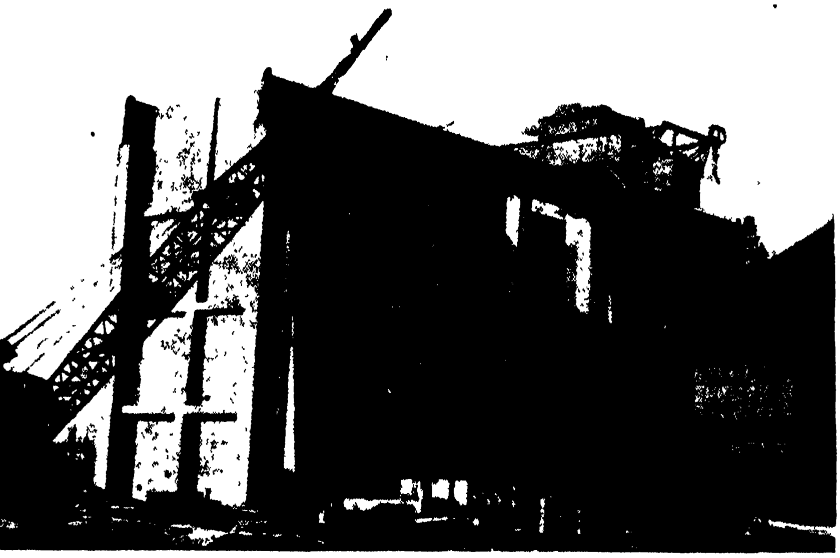
It might be well to add a word of explanation about catalysts, for the benefit of those who find the term an unfamiliar one. In chemistry, a substance which serves the useful purpose of stimulating or facilitating a reaction, without adding to or detracting from the



Where the hydrogen will be manufactured—the gas plant building under construction. The new process consists essentially in adding hydrogen to the oil materials involved, is known as a catalyst. In matrimony, a person who plays a similar rôle is known as a matchmaker. In both instances, they may be very helpful.

Years ago, Dr. Bergius effected the conversion of wood into coal, at a temperature of about 340 degrees, in the presence of water in liquid form. A pressure of about 200 atmospheres was provided as a means of keeping the water from vaporizing at such high temperatures. The water served to prevent super-heating of the newly-made coal, and made it possible to control the physical conditions during all phases of the incoaling reaction.





***Upper:* Pouring some of the 4700 cubic yards of concrete that went into the Bayway hydro plant. *Lower:* Huge concrete slabs enclosing the reaction towers in which hydrogenation actually takes place. Overhead is a traveling crane**

In his coal liquefaction process, Dr. Bergius used ferric oxide with the hydrogen, in apparatus designed to withstand pressures up to 2000 pounds per square inch. At a temperature of 400 to 500 degrees, Centigrade, under a pressure of about 150 atmospheres, the conversion into oil and gasoline took place. The catalysts now used with the Bergius process, as it has been improved for the commercial production of gasoline and light oils, are considered a secret. There also is great secrecy about the exact temperatures and pressures used, and other features such as the design of the high-pressure conversion apparatus.

OTHER investigators, Satatier and Senderens, had found that a nickel catalyst aids in the production of methane gas from coal. The Fischer process of hydrogenation produces benzine by using iron and cobalt as the catalytic agents, and high pressure is not required. In this instance, the catalysts tend to inhibit the formation of methane, and when caustic alkalis are added the conversion continues on down to solid paraffins.

The Bergius process now is being adapted for the conversion of gasoline from heavy crude oils, such as that produced in Venezuela. By present methods of refining and cracking, only a small proportion of gasoline can be extracted from these heavy crudes. Most of the residue is heavy fuel oil, for which there is practically no demand at present.

In the hands of almost any other industrial organization, it might reasonably be feared that the exploitation of the hydrogenation process would bring about chaos in the petroleum industry. However, because of the Standard Oil Company's enormous investment in the oil industry, it is felt that the owners of the hydrogenation process will move with extreme care in order to avoid changing the *status quo* to any great extent.

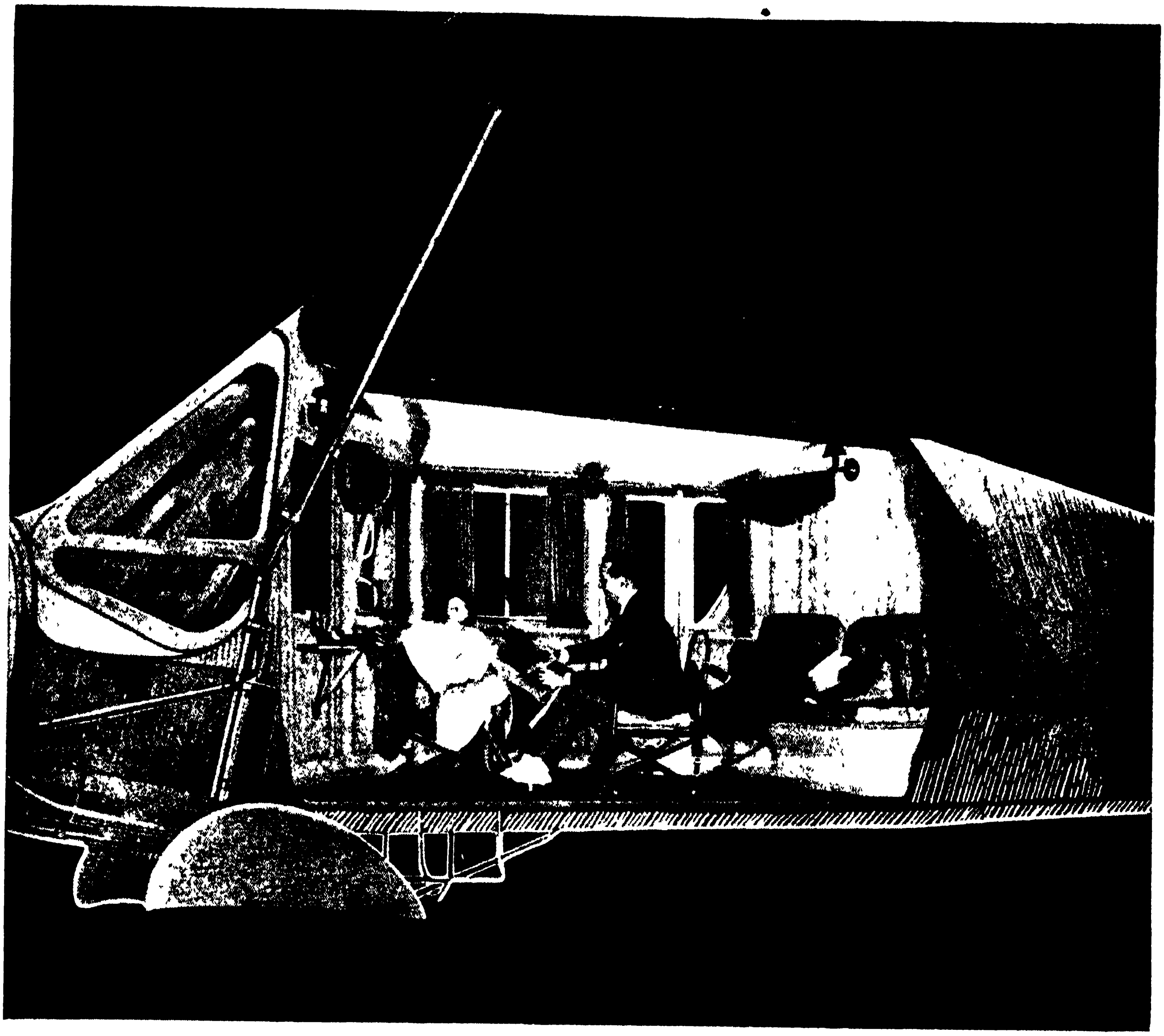
The rights to use the new process in the United States will be leased to other oil companies. Licensing companies will purchase stock in the Hydro Patents Company, a subsidiary of the Standard-I. C. Company, at the rate of one share of stock for each barrel of daily hydrogenation capacity. For example, a firm desiring to establish a plant to produce gasoline at the rate of 20,000 barrels a day will buy 20,000 shares of stock in the Hydro Patents Company.

These outside firms also will be required to align themselves with another subsidiary corporation, the Hydro Engineering and Chemical Company. This organization will furnish the technical information and will supply the catalytic agents. It also will act as engineer in designing, constructing, and supervising the plants of licensees.

ACCORDING to Mr. W. C. Teagle, president of the Standard Oil Company of New Jersey, the future of the oil industry will be determined by the extent to which both producers and refiners recognize that it is not a question of the volume of the products which governs their destiny. It must be realized that the real test is in the industry's ability to measure production to fit the requirements of the consuming markets. The probable effect of hydrogenation upon the petroleum industry is best expressed in Mr. Teagle's own words:

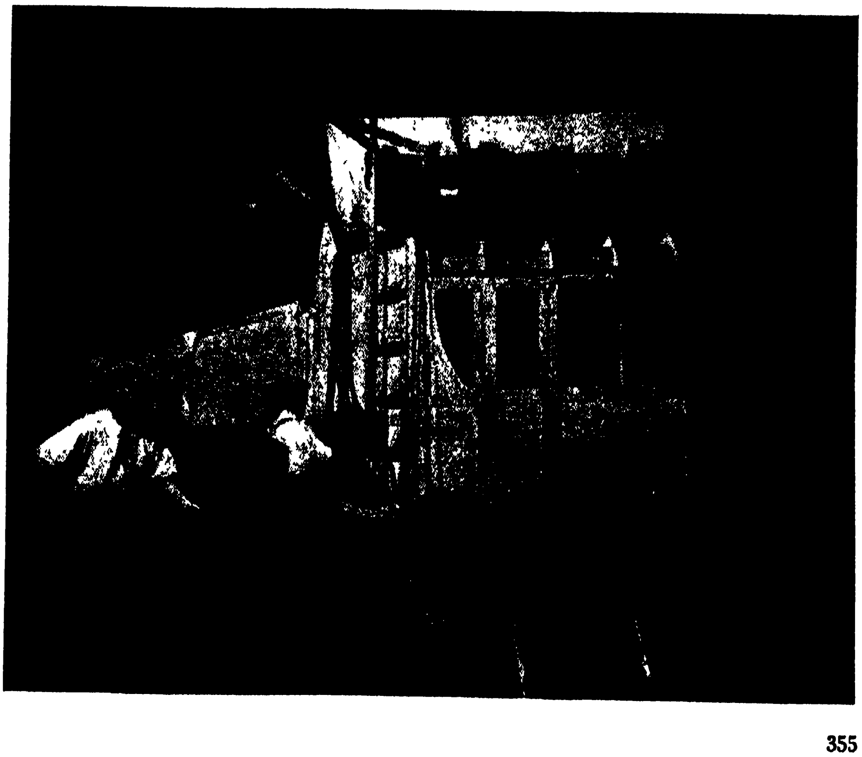
"Through hydrogenation it now is shown to be practicable to convert coal into liquid hydrocarbons at a cost which, although above prevailing oil prices, is not prohibitive. Thus, the coal reserves of the world become supplemental to the crude oil reserves.

"Because of the innumerable new technical problems, solutions of which are required for the practical and profitable use of the hydrogenation method in the oil industry, and because of the relatively large investments required, progress toward its general application will probably be slower than was the case with the cracking development. The ultimate effect, however, should be even more important."



THE STAGE GOES "AIR-MINDED"

ANY play which goes through the hands of David Belasco is sure to be elaborately staged with a fine feeling for detail by this rare artist. His latest production, called "Dancing Partner," has a scene where the lovers are taken aloft in an airplane which cavorts around while fleeting terra firma, clouds, and the starry heavens are viewed through the cabin windows. These illusions are produced by means of projectors carried on the top of the airplane, hidden from the audience by a wing and projecting directly on to the back drop. The electrician controls these effects from the side of the airplane. The huge loudspeaker for the engine effects is located at the left behind the operator who is giving motion to the plane. Another speaker in the dummy cockpit simulates the noise of the propeller and, together with the motions of the landscape and clouds and the sliding passenger seats, serves to give realism to the scene.



EARTHQUAKES

By G. AUSTIN SCHROTER

MANY bizarre theories are prevalent in the popular mind as to the origin of earthquakes and many other unrelated phenomena have been attributed to them, yet they are quite ordinary and commonplace natural processes originating within the outer crust of the earth.

The great Japanese earthquake of 1925 was probably the greatest catastrophe of modern times, and since its advent, Japanese scientists have been among the leaders in seismic studies as well as pioneers in the science of earthquake precautionary measures. Aside from the purely geologic phase of their studies, the Japanese have inaugurated a hitherto undreamed of architectural era in which beauty and safety from crustal movements have been combined.

FOR innumerable years scientist and layman alike believed the source of all seismic activity to be in volcanic activity. Although it is quite true that many sharp local shocks owe their inception to volcanic action, in the aggregate volcanism is rather a subordinate cause of major earthquakes.

There are several types of volcanoes whose classification is dependent upon the types of their eruptions.

The quiescent type, of which Mauna Loa and Kilauea in Hawaii are typical examples, completely lack the catastrophic phenomena of the volcanoes mentioned below. The quiet types give rise to outflows of intensely hot lava, without violent projection of gases or solid material; much as a pot of mush will quietly overflow its container and run down upon the stove top. Quite frequently the pent-up lava content will break through the sides of the vent and peacefully roll down the sides of the volcano until it comes to rest on the slopes below. This type of volcano is of relatively slight importance from the seismic standpoint.

The intermediate (Vesuvius) type of volcano stands midway between the quiet and explosive varieties, and quiet outpourings of lava may be preceded by or alternate with periods of violent explosive activity. This is by far the most common type of volcano, and although local tremors may have their birth in this type of eruption, they usually are of unimportant magnitude.

The explosive type of volcano is, as the name implies, marked by violent explosive activity during the eruptive stage, and sudden ejection of gases, dust, and rock fragments is typical. The most outstanding example is Krakatoa, located in the Straits of Sunda near Java. In the eruption of 1883, Schuchert says that "after premonitory outrushes of gas for some time, the great explosion occurred which blew away over a cubic mile of material from the volcano! The vast cloud of ejected material arose over 17 miles into the atmosphere, completely hiding the sun . . . over a vast area. The noise of the detonation could be heard for over 150 miles, and the atmospheric disturbance affected barometers all over the world!"

All photos by R C Bowes

A fault showing at a road cut. The black lines were drawn in, as the materials were poorly distinguishable in the photograph. They delimit the zone of crushed, ground-up granite. Note the uncrushed pendant within the crushed zone

Small wonder then, that some violent volcanic outbursts give rise to sharp, disastrous, local shocks. These may be due to the effect of the actual detonation on the surrounding rocks, or they may be due to collapse of the crust due to extravasation of underlying lava, just as a building will be weakened and finally collapse if the foundations are gradually removed. Still another explanation of earth tremors in connection with volcanic activity is the sudden violent shattering of hot rock in contact with steam or cold water. This process is similar to the old trick of shattering rocks by heating them in a fire and suddenly quenching them in water. There is little or no proof for this theory of rock-bursts.

IN the year 1811, the lower Mississippi valley was visited by a series of shocks, many of them catastrophic in magnitude. New Madrid in southern Missouri was demolished, and this earthquake was named after the town. Much of this region is an area of limestone rocks which are relatively soluble in circulating ground waters, as indicated by the many limestone caves which abound in the region. It has been suggested that one of the contributory causes to the New Madrid earthquake may have been the sudden collapse of the roofs of certain of these caverns due to the weight of overlying rock masses. It is, however, obvious that other factors must have entered into the case as the shocks were too heavy and too widespread to have originated in this manner alone.

This leads us to a consideration of the most outstanding and common cause for earthquakes, especially of the more sudden, heavy, and frequently disastrous shocks.

That the outer crust of our old earth is constantly undergoing alteration and modification is a fact patent to the most unskilled of observers. The mighty forces of nature seem to be forever in a state of unrest, and they are constantly at work in their task of altering, shifting, and disintegrating the strongest of rocks and the mightiest of mountain ranges.

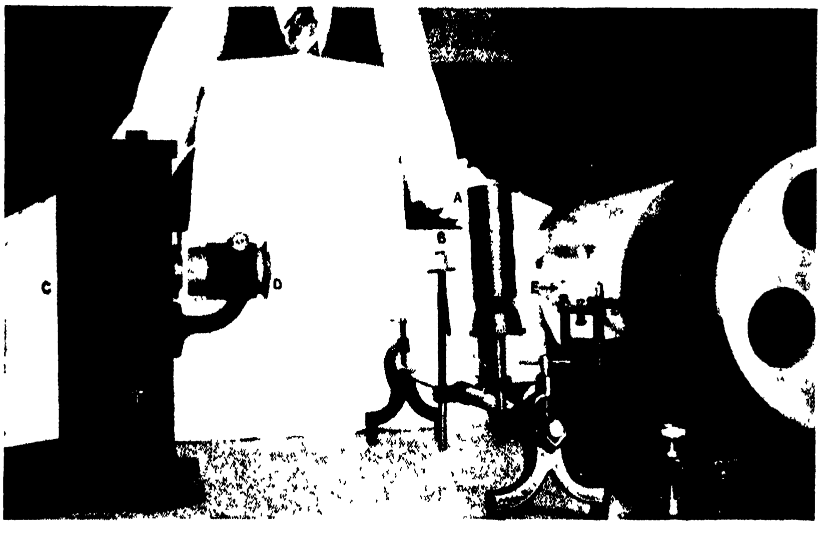
The sea reaches eager fingers to the land, and the sea waves with their burden of sand and littoral material wear away the land, under-cutting the strongest of cliffs, and piling the waste material in spits and bars. Tiny drops of rain fall upon the earth and, as each follows the path to the sea, does its finite bit in wearing and transporting the small products of rock decay. Rills, rivulets, and rivers scour their channels and sweep away portions of the banks, ultimately to deposit their load of silt and sand in the ocean or on some lower flood plain. Winds loaded with dust and sand abrade the toughest of rocks and carry the products of the disintegration many hundreds of miles before they are dropped. Glaciers pluck away whole mountains and move them away. Thus, even the mighty continents themselves are in motion! Throughout the vistas of geologic time mountain chains are worn away and new ones are thrown up to take their places. All of nature is at work in the age-old processes of tearing down and building up.

AN attempt to discuss the details of the stupendous forces of mountain making or of the uplift and subsidence of land masses, would require much space, but it becomes increasingly obvious that, when millions of tons or hundreds of thousands of cubic miles of rock are moved from one portion of the earth's crust and deposited upon another portion, adjustment of the crust must ensue to support the gigantic loads thrust upon it.

Every beam, bulwark, or foundation must have an ultimate breaking point when the loads upon it exceed its strength. And so we find that the crust of the earth must give way in places when the load placed upon it exceeds its strength. In short, a rupture or break is bound to occur, and the broken segments in turn will adjust themselves to the stresses which are acting upon them. Such ruptures or fractures in the outer crust along which appreciable movement has occurred are "faults," and it is to them that we must turn in looking for the most common cause of earthquakes.

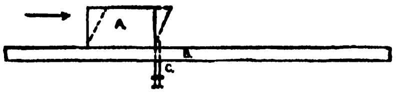
Proof that the great crustal blocks do readjust themselves to the loads thrust upon them is apparent on every hand. Sea shells and the remains of marine organisms are found on the highest mountains, thousands of feet above sea level, old marine strand lines and beaches are elevated far above the reach of the nearest sea waves. Man-made monuments and temples that were constructed within historical times on perfectly dry land are now found to have sunk beneath the sea and been resurrected, not once, but many times. It does not seem so strange, then, that proofs of this constant crustal unrest frequently manifest themselves as shocks, tremors, and ghostly sounds, apparently arising from the very bowels of the earth.

Movements along faults are constantly in progress. No one region is free from them, and if they happen to occur suddenly or with much friction, they are manifested to our senses, but if the slip be slight or gradual, only the most sensitive of seismographs can detect it.



Torsion seismograph perfected by Dr. J. A. Anderson of the Mount Wilson Observatory staff, and Dr. H. O. Wood, Research Associate of the Carnegie Seismological Laboratory at Pasadena, California. A beam of light is sent from the lamp (A) to the prism (B) from whence it is refracted to the mirror of the seismometer within the case (C). The rotating mirror of the seismometer reflects it through the telescopic attachment (D), thence through the cylindrical lens (E) to a strip of light-sensitive paper mounted on the revolving drum (F). The entire apparatus is mounted on a concrete pier within a light-proof cabinet. The optical recording system does away with many difficulties encountered in a mechanical one

No hour in the day, no day in the year, and no region on earth is free from earthquakes. They are as common as life itself, but by far the largest number are not apparent to the senses. The idea that any given region is free from earthquake danger is fallacious. In New England, for example, in the 230 years following its settlement, Schuchert says that over 230 earthquakes have occurred.



A model to illustrate the principle of elastic rebound. An India rubber block (A) sliding over a table top (B) is impeded by an upward projecting nail (C) until it tends to undergo elastic distortion. If the nail is quickly removed while the force is in operation, the elastic properties of the cube will cause it to snap into its original undistorted shape, causing an "earthquake"

Displacement along faults may be horizontal, vertical, or both vertical and horizontal, the latter being the most common type of movement. One of the most recent theories to be held regarding the origin of earthquakes is known as "Reid's theory of elastic rebound," and it may be explained somewhat as follows.

SUPPOSE that a block of India rubber is moved over a table top, as shown in the figure, until the bottom of the block is intercepted in its movement by a nail or peg driven up through the table. If the moving force continues to act, the top of the block will continue to move forward, but the bottom of the block, by virtue of the obstruction will cease to move. As a result, the elasticity of the rubber block will tend to snap it back to its original undistorted position when the obstruction is removed, and the block will assume its former shape and gliding motion with a sudden snap due to the molecular forces within it.

This process is exactly what may occur in two contiguous blocks of the earth's crust. If they are slowly moving past each other due to the stresses of readjustment, and the movement is impeded by a force tending to stop it, stresses will immediately be set up in the two blocks. The stresses will continue to grow until the moving force or the elastic tendency of the blocks overcomes them, or the rock shatters.

When either of these two phenomena occurs, it will manifest itself by a sudden sharp jar or shock, the intensity of which will depend upon the amount of deformation overcome, and upon the intensity of the moving force. The jar will be transmitted instantly to the surrounding crust and waves will be sent out from the point of origin. These are the earthquake waves, and their physical characteristics will determine the amount of damage which they are able to do.

Some faults, quite naturally, are undergoing no movement at present, and are known as "dead-faults." Those which are at present undergoing readjustment are "live-faults." Likewise, some faults are undergoing more rapid readjustment, or are subject to greater stresses, and hence are more pregnant sources of violent shocks.

The great San Andreas rift of California has been studied more in detail, probably, than any other earthquake fault in the world. It has been traced for over 600 miles and forms the boundary between two great crustal blocks, one moving south and the other north relative to each other. It was the San Andreas rift which was the source of the California quake of 1906. In connection with this temblor, it underwent displacement for over 290 miles. Fences and roads crossing it were observed to have been broken and moved apart as much as 20 feet.

MANY earthquakes are due to vertical movement along the source-fault. For example, the great Mino-Owari earthquake in Japan showed a vertical displacement of 20 feet in one place, while the Owens Valley earthquake showed a maximum uplift of 23 feet.

Awe inspiring stories without number have been related by the survivors of great earthquakes, of the fearful sounds accompanying the shock, which were scarcely less terrifying than the quake itself. Tales of unbelievable groaning and grinding noises, of whole forests obliterated, of new streams and waterfalls formed where none before existed, of gaping fissures and dried-up wells, are commonplace and, stranger still, in the aggregate they are true.

For purposes of study, most of the sounds accompanying an earthquake are referred to the Davison sound scale, which is given below:

(1) Sounds resembling wagons, carriages, engines, or trains passing, generally very rapidly, on hard ground, over a bridge, or through a tunnel; the dragging of heavy boxes over the floor.

(2) Thunder; a loud clap or heavy peal, but most often distant thunder.

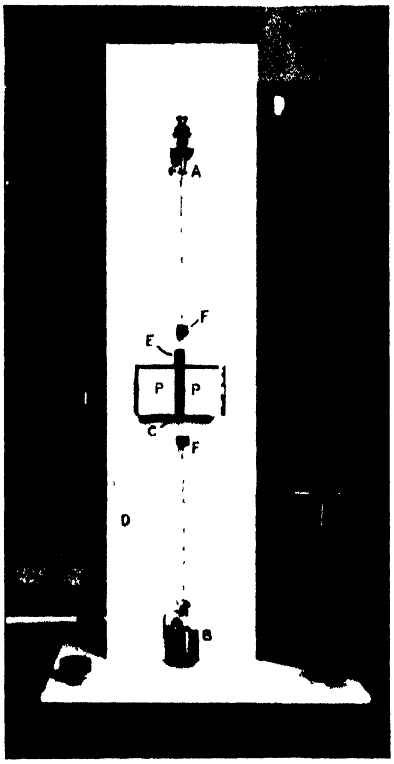
(3) Sounds resembling a moaning, roaring, rough, strong wind, a rising wind, or a heavy wind pressure against the house, a chimney on fire, and so on.

(4) Sounds of great loads of brick, coal, or rock being dumped.

(5) The fall of heavy bodies, banging of a door, pounding of the surf on the shore.

(6) Distant blasting, explosives, firing of artillery.

(7) Miscellaneous sounds such as the roaring of a waterfall, rending or tearing sounds, or the sounds of an immense covey of partridges on the wing.



Enlarged model of the torsion seismometer. A fine tungsten wire is suspended from the screw clamp (A) to the tension attachment (B). A copper cylinder (C) is mounted eccentrically on the wire. When the standard (D) vibrates, the cylinder, due to its inertia, tends to remain at rest. Torsion is set up in the wire causing rotation of the tiny mirror (E) about the suspension. A beam of light can be reflected from the mirror to a sensitized paper on a revolving drum, thus obtaining a photographic record of the shock. A magnetic field from the poles (P) damps the vibrations of the torsion pendulum. The vibration of the wire as a whole is damped by the reservoirs (F) filled with castor oil. This instrument is for use with the horizontal components of the waves. The vertical components are measured in the Carnegie Seismological Laboratory at present, on a seismometer perfected by Mr. Hugo Benioff, Research Associate

The different sounds of the Davison sound scale vary, of course, with the distance of the observer from the source of the earthquake. They may resemble the roar of a train through a tunnel in one place and the low moaning of wind in another. They may be audible to one person and entirely inaudible to another, depending upon the individual's sense of hearing. The author has many times detected the sound of thunder or heavy explosive blasts in connection with seismic activity.

The most outstanding characteristic of these seismic sounds is their extreme lowness or depth of tone, which helps to explain why they may be difficult for some persons to hear. The accompanying sounds owe their origin, of course, to the vibrations set up in the rock by the quake, just as an organ reed vibrates and causes different sounds by different intensities of vibration.

So-called "tidal waves" are another phenomenon accompanying earthquakes, especially in those of submarine origin. These waves have no relation to the tides, but are caused by the elastic rebound of submarine rock masses. In strong submarine earthquakes, the effect on ships is much as though they have struck on a rock or grated over a reef. Seismologists call these vast sea-waves *tsunamis*, from the Japanese, or when they are observed in bays or inlets, as *seiches*, especially when they are stationary waves. They may be as much as 100 or 200 miles from crest to crest, 40 feet high at the point of origin, and they may sweep across the seas with a speed of from 300 to 500 miles per hour. Such *tsunamis* may be unperceived in the open ocean, but upon reaching the land they may pile up as great waves and sweep far inland with great loss of life. Such were the waves that played havoc with Lisbon in 1755, Japan in 1854, and Peru in 1868.

EARTHQUAKES may dislodge loose masses of earth or rock, cause landslides or avalanches, and thus completely denude forest slopes, or dam streams and rivers giving rise to new lakes and "sag-ponds."

The study of earthquakes and earthquake phenomena is seismology, the instruments that are used for detecting and recording earthquakes are seismometers and seismographs, and the record obtained of an earthquake with a seismograph is a seismogram.

The principle of the seismograph is relatively simple. The instrument consists of a heavy mass of metal which by its inertia tends to remain at rest while the ground beneath it vibrates. If a pointer is fastened to the inert mass, and a calibrated drum which will move with the vibrations of the ground is rotated in contact with the pointer, the pointer will leave a record on the drum of the intensity of the shock, and of the frequency, amplitude, and period of the accompanying waves.

The classic example of the seismograph, and at the same time, one which is easily constructed, is a heavy steel ball or bearing placed on a smoked glass plate. If a shock occurs, the ball will tend to remain at rest while the glass plate under it will vibrate to and fro, and a record of the "quake-tracks" will be left on the soot.

The ideal seismograph should be able to record the wave motions in three dimensions; that is, north-south, east-west, and up and down. So far, no such ideal instrument has been devised and in practice it is necessary, if accurate results are required, to use two types of instruments, one for vertical, the other for horizontal components.

The movements of the ground during an earthquake shock may be of two kinds: (1) in large earthquakes, there may be a sudden, large displacement, or a violent lurch of the crust, either horizontal or vertical, or in both planes, or (2) as in all earthquakes, there is a vibratory motion of the ground. The measurement of the former, the great lurches or sudden displacements, can not be accomplished by seismographs. When they take place the ordinary seismographs are thrown out of action or damaged. For recording the vibratory movements, the latter, it is necessary to have two sets of seismographs, one for near, and the other for distant, shocks.

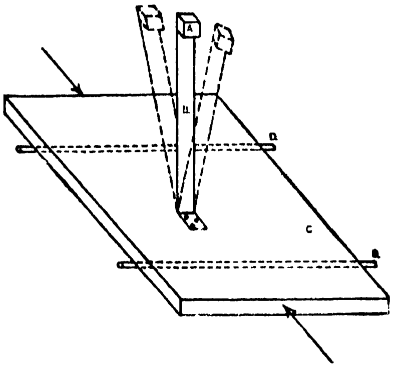
A STUDY of seismograms has indicated that the main shock is preceded by smaller, so-called "fore-shocks," and followed by slighter "after-shocks." The fore-shocks are due to the waves which have taken the shortest path from the source of the temblor to the instrument *through* the earth. The waves of the main shock are those which have traveled *around* the periphery of the earth. After-shocks are usually the result of final readjustment to stresses along the fault. In the Italian earthquake of July 23, 1930, the after-shocks continued for several days after the main, destructive shocks, and did much damage to buildings already weakened.

If three or more stations accurately record the shock, it is a fairly easy matter to calculate the origin of the earthquake. The greatest difficulty is to record the exact time of arrival of the quake at any one station so that the relative time may be determined.

The Seismological Laboratory of the Carnegie Institution of Washington, which is situated at Pasadena, California, is connected with a network of seven recording sub-stations located at Tinemaha, Haiwee, Santa Barbara, Riverside, Pasadena, Mount Wilson, and La Jolla, California. The time of arrival of a wave at any station is co-ordinated with the other stations by means of a dot-dash radiogram from a powerful, long wave, radio station. Thus, if a wave arrives at Pasadena at the beginning of a dash, and at Santa Barbara at the end of a dash, the relative time of arrival between the two stations can be calculated, and the ultimate source of the quake located.

Although, as has been mentioned, no locality is free of earthquakes, certain regions are more liable to dangerous tremors than others. These large well-defined tracts are known as seismic belts. One of them borders the Pacific Ocean, and follows the west coast of South and North America, Alaska, the Aleutian Islands, and the islands off the coast of eastern Asia. The other seismic belt borders the Mediterranean, the Alps, the Caucasus, Himalayas, and so into the East Indies.

The seismic belts follow in general the great zones of weakness in the crust of the earth. For example, off the west coast of the Americas the land is rising with respect to the ocean floor. In regions of active mountain making, great river deltas, rising or subsiding land tracts, and so on, the danger of heavy shock is more imminent.



A model to illustrate the motion in tall buildings or high stacks. The heavy metal bob (A) is mounted on the flexible brass pendulum (B) which in turn is screwed to the base (C). The base is free to roll over the rollers (D). A slight back-and-forth motion of the base will cause the pendulum to swing through a constantly growing arc

In accordance with what has been said regarding the origins of earthquakes, it would seem that in a region where many recurrent slight shocks are prevalent or common the danger of heavy damaging shocks is less. Conversely, in regions of seismic activity, periods of long quiescence may be the forerunners of a violent earthquake.

To the American people, perhaps the most horrific example of an earthquake in the rôle of a destroyer was the great California earthquake of 1906, which resulted in untold suffering, property loss, and a casualty list of close to 1000 lives. The city of San Francisco suffered the greatest loss, due in large part to the destructive fire which swept unchecked over the city following the quake, owing to destruction of pipelines by the tremors.

On the 28th of December, 1908, the two cities of Reggio and Messina in southern Italy, were completely destroyed with a loss of life of approximately 200,000 souls. The more recent Italian earthquake of July 23, 1930, probably had its inception in the same region, which is an active seismic one, and had the proper precautionary measures been observed, the loss of life in both of these disasters would have been very greatly reduced. In general, the least risky part of the earthquake cycle is the period after a quake; while the stresses once more accumulate after several years. Yet, such is human nature, much attention is given to precautionary measures at the former part of the cycle, but the least at the later time of increasing risk.

THE greatest danger to the populace during an earthquake arises out of poorly constructed buildings and the tendency to become panicky. By referring to the accompanying figure, the danger to be expected from very high buildings becomes obvious. A high building during a shock may act as an inverted pendulum, so that a very slight oscillation of the ground will be greatly amplified in the upper portions of the structure. Notice a clock pendulum at the point of support. The arc through which it swings is slight. At the bob, however, the arc of swing is greatly amplified, and it is in this principle that the danger from high buildings lies.

In an active seismic region the heights of buildings should be, and frequently are, limited. The danger from falling cornices, high smoke stacks, and perched water tanks can not be stressed too much. In a metropolitan district, it is far safer to run into a Class A building than into the street during a tremor, as the greatest danger lies in falling objects rather than in collapse of walls. Buildings on filled or made ground, likewise are in more danger of collapse than similar buildings built on bed rock.

Movements are now under way, in many of the larger cities, to pass ordinances requiring that buildings be designed to withstand horizontal stresses as great as the stresses upon their foundations. Large buildings, dams, and similar structures should never be built over or close to a live fault, as the danger is imminent. Brick buildings, unless highly reinforced, should be avoided in active seismic regions.

The science of seismology is still in its infancy, so that it is difficult to predict just what strides in earthquake prognostication will be made within the next few years. It is certain, however, that at present, no person can predict the time of occurrence of an earthquake in advance. The old superstitions that earthquakes are more apt to occur during the summer in preference to other seasons, or that they are preceded by "earthquake-weather," is so much rubbish. No good can ever come of such fallacies. They should be relegated to oblivion with the old superstitions of witchcraft and astrology.

Multiple unit cars in service on the Illinois Central in Chicago. Passenger cars of this type are widely used in suburban and urban service

RAILROAD ELECTRIFICATION

By FRANCIS H. SHEPARD

Director of Heavy Traction, Westinghouse Electric and Manufacturing Company

WIDESPREAD opinion has it that automobiles, buses, and airplanes are taking the business of the railroads and that, therefore, they are being electrified for economy's sake. Neither the postulate nor the conclusion is correct. While railroads admittedly are not now operating on a high-profit basis, there is a steady increase in freight shipments and even an increase in long-distance rail travel and far-sighted authorities are very optimistic for the future. Economy has no place in the American scheme of electrification, for the operating economy on electrified American roads is practically nil. Mr. Shepard has, in the accompanying article, given us the truth, as an expert sees it, about rail transportation, its relation to the electrification problem, and the full significance of the latter—what it means to railroads, to the investor in railroad securities (who will read between the lines), and to the country at large.—*The Editor.*

RAILROAD electrification in the United States is entering into an era of increased activity. Several of our railroads are now beginning to electrify their main lines and others are actively considering plans to the same end. The cost of projects at present actually under way exceeds a hundred million dollars, and the total for those contemplated is many times that amount.

Much the same tendency is noticeable throughout the world. All of the nations listed in the accompanying table are either extending or planning to extend their electric service, and, in addition, electrification work is under way in seven or eight other countries.

No single cause is responsible for all this interest. Electricity as a tool for moving traffic has a number of advantages, some of which may be the determining factors in one case while totally different ones may govern in another.

IN many instances, especially outside the United States and Great Britain, the fuel situation provides the underlying motive for electrification. When a nation lacks abundant supplies of first-class coal but is favored with ample waterpower or some form of low-grade fuel, the use of electricity for railroad operation not only may effect a large saving in operating expenses but means independence of coal-producing countries in times of emergency. Switzerland, which has already electrified almost half of her route mileage, furnishes a typical example of this condition, and in the same category are Austria, Brazil, Chile, Italy, Norway, Sweden, and, to a lesser degree, France and Germany.

In this country, on the other hand, where the cost of coal and oil is comparatively low, little or no operating economy would result by saving fuel through electrification; the fixed charges of the electric installation would, in general, be greater than the cost of fuel saved. In the decision to carry out one American electrification—that of the Chicago, Milwaukee & St. Paul—the use of waterpower played an influential part, but all the other installations in the United States were due to other considerations, which can be summarized as follows:

Tunnels. The original application of

IMPORTANT ELECTRIFIED RAILROADS OF THE WORLD

	Electrified Route Mileage	*Total Route Mileage*
United States	**2500**	**251,000**
Argentina	**68**	**23,000**
Australia	**230**	**22,300**
Austria	**450**	**4370**
Brazil	**251**	**18,700**
Canada	**40**	**40,000**
Chile	**210**	**5400**
Cuba	**155**	**3800**
Czechoslovakia	**30**	**8800**
France	**875**	**33,000**
Germany	**975**	**36,000**
India	**150**	**38,000**
Italy	**1070**	**12,000**
Japan	**200**	**13,000**
Morocco	**150**	**900**
Norway	**115**	**2000**
Spain	**370**	**9700**
Sweden	**730**	**9800**
Switzerland	**1550**	**3600**
South Africa	**200**	**11,800**
United Kingdom	**450**	**24,000**

electric power for main line haulage was made in 1895 by the Baltimore and Ohio Railroad for the purpose of avoiding smoke conditions in its long tunnel under the city of Baltimore. The success of this undertaking and subsequent development led to the use of electricity by the New York Central, the New Haven, and the Pennsylvania railroads for their tunnels into New York City, by the Boston & Maine for the Hoosac Tunnel, by the Grand Trunk for the St. Clair Tunnel, and other installations.

SUBURBAN and Terminal Service. The development of the electric street railway and, especially, the use of electrically-operated trains on the elevated railways of Chicago and other cities, showed that electric operation was superior to steam in many respects for heavy suburban service. Electric motor-car, or "multiple-unit," trains accelerate more rapidly and hence can make better time than steam trains, even if the maximum speeds of both are the same; on running into a terminal they can be run out again without further switching, whereas several car movements are needed to reverse a locomotive-hauled train, which not only require time but may congest the tracks outside the terminal; they can run through residential districts without seriously affecting real estate values; and, of course, they can move freely in tunnels of any length.

For these reasons, electric operation was adopted by the Long Island and the New Haven railroads in the vicinity of New York, the Pennsylvania at Philadelphia, the Illinois Central at Chicago, and the railroads around London, Paris, Melbourne, and other large cities.

Mountain Grades. Of a group using electric operation for totally different reasons, the Virginian Railroad is typical. The chief business of this road is to haul coal from West Virginia to tidewater at Norfolk, Virginia. Its line crosses the Allegheny Mountains and at one point some very heavy grades against traffic are encountered. Under steam operation, these grades formed the "neck of the bottle" for the railroad. Even with the use of the most powerful of steam locomotives, traffic slowed down here and the capacity of this portion set the limit to the entire road.

In order to increase this capacity, which was becoming more and more necessary, there were two alternatives: to retain steam operation and increase the number of tracks, or to increase the power for each train by using electricity. Owing to local conditions, the cost of additional tracks would have been exceedingly high, so electric operation was decided upon. Today, locomotives applying at times more than 20,000 horsepower per train are in use on this road, and trains are being moved up the steep grades at twice the former speed. The net result has been to increase the capacity of the road by more than 100 percent, with even greater capacity available if needed.

Other railroads using electric power for mountain-grade divisions include the Norfolk & Western and the Great Northern.

IT is obvious, however, that if these reasons alone influenced electrification in this country, we would see no general use of electric power here. The electrified areas would be confined to the great cities, the mountainous districts, and some special localities, but steam would be employed everywhere else. This, indeed, was the situation until very recently—until, in fact, the Pennsylvania Railroad announced its plans to electrify its entire system of all services from New York to Washington and as far west as the vicinity of Harrisburg, Pennsylvania.

In order to appreciate the full significance of this electrification, which is the most extensive and comprehensive one in the world, it must be considered in relation to our transportation situation as a whole.

Railroad transportation is vital to the United States. Because of it, our vast territory has been developed and our people have been held together as a single nation. The moment our transportation service fails to meet our needs —as it did during and immediately following the war—everyone suffers: the price of everything we purchase and the cost of everything we produce promptly rise.

Crossing Hell Gate Bridge on the New Haven: The Colonial Express with its 178-ton electric locomotive

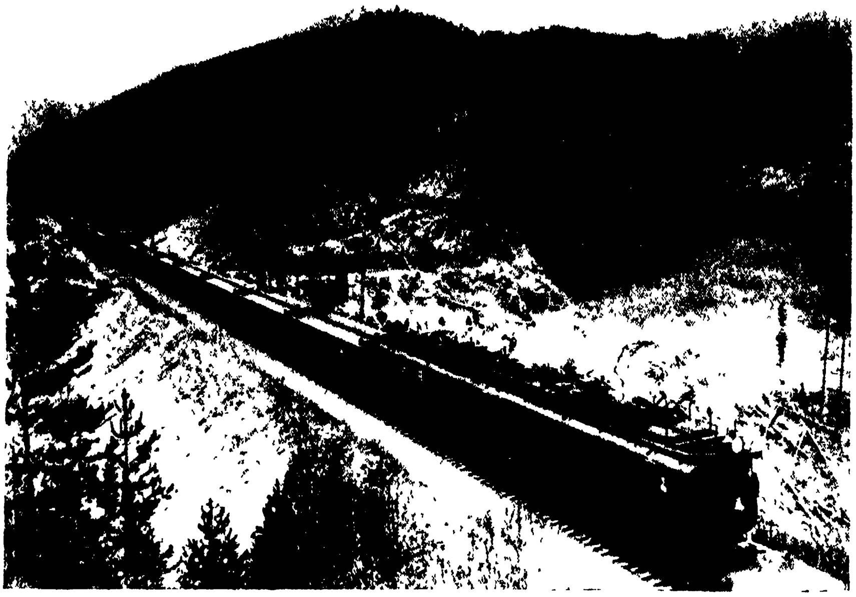
OUR demand for rail transportation far exceeds that of any other people. We require 4000 ton-miles per capita, whereas the British requirement is about 500 ton-miles. And this demand has shown marked growth: our ton-mileage for 1900 was 100,000,000,000, and today it is 440,000,000,000; and although with the present trend the aggregate is not increasing, this may be assumed to be only a temporary condition. It is true that a decrease in passenger movement has taken place recently due to the advent of the automobile, but this applies mainly to local and branch line service. On the other hand, there has been a pronounced increase of passengers traveling long distances and between populous centers. The automobile is, in fact, creating traffic by increasing the general movement of our people, by opening up areas for residence which were previously inaccessible, and by making us more travel- and speed-minded. The airplane is also acting in this same direction.

In spite of increase in the demands upon our transportation system, there has been practically no increase in the

A 6000-ton coal train on a 2 percent up grade of the Virginian Railroad, hauled by three 215-ton, 11,000 volt, single phase, Westinghouse-equipped power units

number of freight-train-miles or in the number of locomotives for the past 20 years. This means that our train units are becoming progressively heavier, and trains are being moved at higher speeds. The increase in ton-miles per hour has been nearly 50 percent in less than 10 years. The size of the locomotive has likewise grown, and the trend is conclusively toward more and more horsepower per train.

Rail traffic, like automobile traffic, seeks those highways which are most advantageously situated. Half of our route miles carry about 90 percent of our traffic; while the great trunk lines, which constitute only about 10 percent of our route mileage, handle at least half the traffic. There is, therefore, an increasing pressure of traffic on these major routes which has been met by increasing the size and speed of the trains.

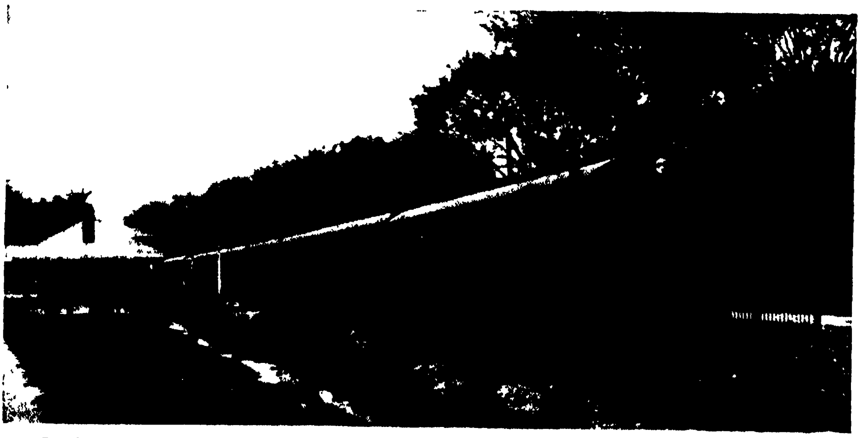


A crack silk train of the Chicago, Milwaukee, and St. Paul drawn by a 300-ton, 3000-volt direct current, Baldwin-Westinghouse electric passenger locomotive

SO far, the steam locomotive, which has recently undergone conspicuous and notable development, has kept pace with our needs and will continue for many years to be the mainstay for most railroad mileage; but there may be serious question if it can meet the demands of intensive trunk-line operation after the next 20 or 30 years. Double and even treble the present movement may conceivably be the requirement.

With electric operation, on the other hand, the amount of power that can be applied to each train is practically unrestricted, and electric trains of any size can be operated at any speed within the limits set by the road-bed, draw-bars, and other mechanical equipment. Hence, an electrified railroad has greater capacity than the same road under steam power. To electrify a rail highway is to broaden it.

Behind the great electrification undertaking of the Pennsylvania Railroad, therefore, may be seen a recognition of our future transportation needs, a vision of an unhampered and ever-expanding flow of traffic, and the desire to give the public the utmost in railroad service.



Multiple unit operation in heavy duty suburban passenger service on the Long Island Railroad. This is a familiar type of car in many metropolitan localities

Important also is the inauguration by the Reading Railroad of the electrification of its lines radiating from Philadelphia; and it is understood that ultimate extensions will be made for high speed and through service. Increasing interest is also being manifested by other railroads in electrifying sections of their main lines.

Parallel to the progress in developing the utility of railroad electrification, has gone on an evolution in the kind of electric power employed. All the early systems followed street railway practice and used direct current at 500 volts supplied by a third rail. In 1902, B. G. Lamme, Chief Engineer of the Westinghouse Company, announced the results of his experimental development, sponsored by George Westinghouse, of an alternating-current motor which could operate at all the various speeds and under the different conditions required by railway service. This announcement, which indicated the possibility of serving any track with a single, working conductor at any desired voltage and of supplying power to trains in any desired amount, instantaneously and effectively, aroused world-wide interest.

IN 1905, the New York, New Haven & Hartford, being governed by plans for future extension, adopted the new alternating-current system with overhead conductor at 11,000 volts. This method of operation has since been adopted and made standard by Norway, Sweden, Germany, Austria, and Switzerland, and, in this country, by the Grand Trunk St. Clair tunnel installation, the Hoosac Tunnel of the Boston & Maine, the Great Northern, Pennsylvania, Norfolk & Western, and the Virginian Railroad.

The success of the high-voltage overhead system of the New Haven stimulated the development of high-voltage direct-current equipment, and this current has been applied for various lines at 1200, 1500, 2400, and 3000 volts. Shortly after the war, the French Commission decided upon 1500 volts, direct current, as the official standard for France. The same system is in use in Japan, Java, Holland, and some other countries, while 3000 volts direct current is in use in South Africa, Chile, and Brazil, and by the Chicago, Milwaukee & St. Paul in this country.

The most extensive electrifications now being carried out in this country are with single-phase alternating current, as this system has greater promise for future advantage than any other.

ANOTHER PEKING SKULL DISCOVERED[1]

By PROFESSOR G. ELLIOT SMITH, F. R. S.

AT a meeting of the Geological Society of China in the last week of July, Prof. Davidson Black announced the discovery of another skull of Peking man.

In *Nature* of March 22, 1930[2], an account was given of the discovery of a series of remains of *Sinanthropus*, culminating in the recovery of an almost complete braincase by Mr. W. C. Pei on December 2, 1929, while clearing a sheltered recess of the main deposit at Chou Kou Tien. Some days before this skull was found, five human teeth were recovered from a spot higher up in the shaft, where they were associated with the skull of a large deer and some pieces of fossilised bone and blocks of stone, which were brought to the laboratory in Peking for examination.

This material was "developed" during the third week in June by the technical assistants working under Professor Davidson Black's supervision, and he found that there were enough fragments, which fitted together, to form the greater part of another uncrushed skull of *Sinanthropus*. He waited until the return to Peking of Dr. Wong (Wong Wen Hao), the Director of the Survey, before making the public announcement of his important discovery.

FOR reasons which are not yet clear to those who have not seen the actual specimens, Professor Davidson Black regards the skull found on December 2, 1929, as that of a young woman, and the calvaria, the discovery of which is now reported, is in his opinion that of a young adult male. It conforms to the same general type as the skull previously found, and its proportions are similar. But the braincase is not so thick and the frontal eminences not so pronounced. The most interesting new fact revealed in this discovery is the nature of the root of the nose, which is broad and flat, quite unlike that of Piltdown man.

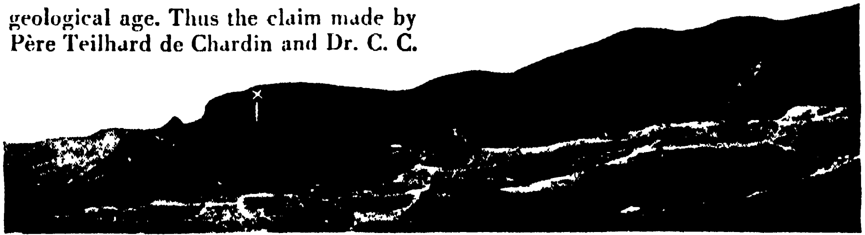
The newly discovered skull was found in association with a number of teeth which can be assumed to have belonged to the same individual. This fact adds to the interest of two mandibles found in 1928 in association with the crushed parts of the respective braincases.

The remains of four skulls of *Sinanthropus* and teeth of at least six other individuals have so far been found. Thus there is available for study in China a much richer material of early Pleistocene man than the fragments of the individual specimens of *Pithecanthropus* and *Eoanthropus* provide. Moreover, the geological age of the Chinese fossils can be established with more certainty than that of the other two primitive genera, which are assumed to be roughly contemporaneous.

The fossils from Java and Sussex were found in gravels, where they had been deposited by running water. Although there is little doubt which of the heterogeneous fossils found in these gravels were contemporaneous with the human remains, in the case of the men of Peking, who left their bones in the cave where they lived, there is less room for doubt that the bones of animals deposited alongside them provide more certain data for the estimation of their geological age. Thus the claim made by Père Teilhard de Chardin and Dr. C. C. Young that *Sinanthropus* lived in Lower Pleistocene times rests upon a surer foundation than the similar claims that have been made in the cases of *Pithecanthropus* and *Eoanthropus.*

Further, the conditions under which the discoveries are being made at Chou Kou Tien hold out a greater promise of further evidence than in the cases where the fossils have been scattered by running water. Thus a series of fragments have already been recovered every autumn since the type tooth was recovered in 1927, and it is not unreasonable to expect that much more still remains to be found in this cave, and possibly in other fossil beds in the neighborhood. So far no worked tools have been found in the cave; but if such should be recovered, their association with the human remains will be less uncertain than in the case of the other Pleistocene men's implements.

FOR these reasons, in addition to the intrinsic interest and morphological significance of the skulls of *Sinanthropus,* the discoveries in China have an importance which is unique. It is a matter for congratulation that the investigation of this site should have fallen into such competent hands and that ample facilities and skilled assistance should be available for the work, which is being conducted with great thoroughness and insight.



Illustrations courtesy of *Illustrated London News*

Where the remains of *Sinanthropus,* the Peking man, were found—in a cave on the side of a steep hill, at the spot marked X in the picture reproduced above

After a photograph by Father Teilhard de Chardin and C C Young

A panorama of the region around Chou Kou Tien near Peking or, as it is now called, Peiping. The small hill at left of the center (with elliptical shaded face) is the one which shows, much larger, in the upper picture which is a close-up view

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[1] Reprinted from ***Nature*** (London) by permission.

[2] See also *Scientific American,* June and September, 1930, containing other articles on *Sinanthropus* by the author.—*The Editor.*

HOW PLUTO'S ORBIT WAS FIGURED OUT

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

NOW that the new planet has been detected upon photographs taken years ago we can be sure that we have a good idea of its orbit. But doubtless many people still are wondering why it took so long to be sure in what sort of path it was moving.

How astronomers can work out the orbit of a planet which they have been observing but a few weeks is a mystery to most people. Indeed we might go further, for even the graduate student of the science, who has gone through the long chapter of mathematical formulae to be found in treatises on the calculation of orbits and the still longer computations which actually apply them, has often no very clear idea of the *rationale* of the complicated process. He can not see the woods for the trees.

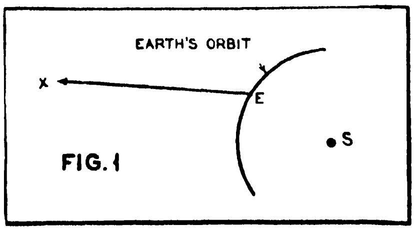

FIG. 1

Yet the thing is not really so hard to understand and, with due apologies to the reader whose tastes do not run along mathematical lines, let us for once consider the reader whose interests do, and try to explain as simply as possible how the apparently impossible thing is done.

FIRST of all we must realize what our planetary observations actually tell us. They give the apparent place of the body in the heavens among the stars; that is, each observation tells us very precisely in just what *direction* the planet lay from the earth (more precisely, from the particular spot on our planet where the observation was made) at an exactly specified moment. But an observation by itself tells us nothing at all about the planet's *distance*. Since the earth's motion about the sun can be accurately calculated we know just where it was at the time of observation (say at E in Figure 1). We can lay off this point on a diagram and also draw in the line EX which runs in the direction in which the planet was seen. (This line would usually run a little above or below the plane of the rest of the picture, but we may leave such details to the actual computer.)

But *where* is the planet upon this line? This is the main problem and it would be very difficult to solve if we did not know the laws according to which the planets move. Suppose that we have two observations, made at the time when the earth was at E_1 and E_2 (Figure 2). If the planet was standing still in space we could locate it at the intersection Y of the lines E_1X_1 and E_2X_2 on which it lay at these moments. But it was actually moving, and so can not have been at Y, wherever else it was.

NOW—to take a simple case first—suppose that the planet's orbit is a circle. We may then make any guess we please about its distance (say SR in Figure 2), draw a circle with this radius and find two points P_1 and P_2 at which the planet must have been if our guess was right. But *was* it right? We can test this by using Kepler's Third Law—that the squares of the periods of the planets are proportional to the cubes of their distances from the sun. We can find by measurement on our diagram, or far more accurately by calculation, what fraction the arc P_1P_2 is of the whole circumference. We know the time taken between these points and so can calculate what would be required to complete the whole orbit at this rate. If the result agrees with Kepler's law our guess was right. If not it was wrong and we try again with a new assumed distance SR′ and get two new positions P'_1 and P'_2. This time perhaps we find a motion slower than Kepler's law allows, whereas the first time it was too fast. The true value then lies between our two guesses and a few more tries will lead us step by step to the correct result.

Such calculations are often made in the case of a newly discovered asteroid to get a rough idea of its orbit and predict where it may be found a month or so later. Most of the characteristics of the general problem are well illustrated by this simple case. In the first place we see how the application of the law of motion turns an apparently hopeless problem into a very simple one. Secondly, we may note that a very small error in our observations may cause a serious one in our results. Suppose that we have got the direction of one of the lines, say E_2X_2, a little wrong. The distance P_1P_2 will then be wrong and, when we compute the time required to make the circuit of the whole orbit from that of this short arc, our error will be greatly magnified; and the same will be true of the final calculated distance. For this reason the computer must assure himself at the start that the observations which he uses have been made with skill and care before he wastes time on useless calculations.

AGAIN we may notice that our problem, as illustrated in Figure 2, admits of two solutions. Instead of starting with an assumed distance less than SY we might have adopted a greater one (SR″ in the figure). We would then have found the planet moving backward about the sun, but by the same process of trial and error we could have hit on an assumed distance at which the rate of motion would agree with Kepler's law. Two quite different planets, then, one relatively near the sun and moving forward, the other farther away and moving backward, each in a circular orbit, might both have been exactly on the observed lines at the correct dates. Later on, of course, their directions from the earth would differ and a third observation would tell which was the true answer (practically, since all of the thousand and more known planets move forward, no doubt would arise).

When the orbit is an ellipse (or a parabola or a hyperbola in the case of a comet) the problem of calculating it is much more complicated but the principles which have just been illustrated still hold good.

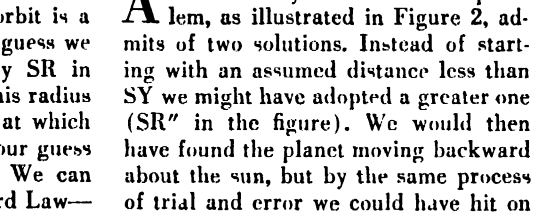

FIG. 2

In this case we must have three observations instead of two—which can be seen from very general considerations. If we have to find the values of a certain number of unknown quantities

—say six—we must have an equal number of equations (or, more generally, of known relations) from which to find them. No algebraical skill can get out the values of all six from only five independent data.

Now each observation of a planet gives us two such independent data, the right ascension and declination. To specify completely a circular orbit we require four "elements"—the node and inclination of the orbit plane, the planet's distance from the sun, and its position on the orbit at a given instant. Two complete observations giving four data to work on should therefore just suffice to work out a circular orbit; as they do. For an elliptic orbit there are two more elements to be found—the eccentricity and the longitude of perihelion, making six in all; and three observations will give us just what we need for a solution.

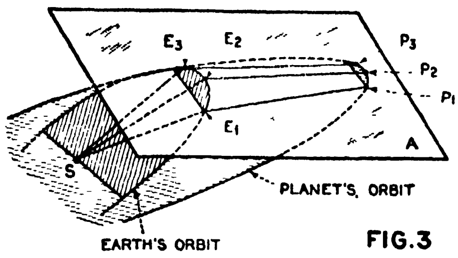

FIG.3

Once again the principal problem is to find the planet's distance. How it is done may best be explained by going back directly to the law of gravitation. We have now to take account of the fact that the orbits of the earth and the planet are in different planes both passing through the sun, as shown in Figure 3. $E_1E_2E_3$ and $P_1P_2P_3$ are the positions of the earth and planet at the three dates of observation. It is always possible to pass a plane A (the least shaded one in the figure) through the line E_1P_1 in such a way that E_3P_3 is parallel to it (though in the case represented lying higher) and E_3 and P_3 are at equal heights above the plane. Now the sun attracts both the earth and the planet, so that their orbits are curved and E_2 and P_2 lie higher than the other two points on each orbit. But since the earth is nearer the sun than the planet, the sun attracts it more strongly and curves its orbit more, so that E_2 will be farther from the one line than P_2 is from the other, and will be higher above the plane A than P_2 (the more so because the earth's orbit is more highly inclined to A than is the planet's). Hence the line E_2P_2 will not be parallel to A, but will slope downward and meet it at some point beyond P_2.

THE angle of this slope may be found from our observations, which tell us just where the three lines are—though not where the points P lie on them.

Now, making any convenient assumption about the distance E_2P_2, it is possible to calculate the influence of the sun's gravitation in curving the planet's orbit (that on the earth's is of course known) and hence to find what the slope of this line should be. Successive trials would then lead us to the correct value. When, as in practice, the arcs E_1E_3 and P_1P_3 are but small parts of the orbit it is possible to set up an algebraic equation which saves the time-consuming process of solution by trial and error and gives the desired distance directly. This equation is of the eighth degree but its solution has been made much easier by the calculation of special tables and presents no great trouble. When once the planet's distance at the time of one observation has been determined, its distances at the other two dates may be found by another equally simple application of the laws of motion under gravity (which, however, we have not space to describe in detail). To calculate the orbit about the sun is then easy enough. It may be noticed that, though the planet's orbit is drawn as an ellipse in the figure, the same reasoning would apply in the case of a hyperbolic comet. In fact the solution leads automatically to a determination of eccentricity of the orbit and the size and shape, whatever they may be.

ONCE again a small error in any of the observations is likely to be greatly multiplied in the results of the calculation. A "first orbit" based on all three observations is therefore usually of low accuracy. It serves completely, however, for predictions good enough to keep track of the planet until, some months after the discovery, it is lost to observation in the vicinity of the sun. Then by utilizing the data obtained in this interval a better orbit can be calculated, sufficient for finding the planet next year, and sometimes, as has recently been illustrated, on old photographs; and then a still better orbit may be calculated.

The general equation for finding the planet's distance has sometimes one real solution and sometimes three, leading to three different orbits in any of which a planet could move so as to be on the three given lines at the given instants. Charlier the distinguished Swedish astronomer has, however, shown that when a body is observed near opposition there can only be one solution of the problem and this is practically always the case for planetary discoveries. For a comet observed near the sun there may be three solutions, as happened for the great daylight comets of 1843, 1882, and 1910.

For a distant body like the new planet Pluto the apparent motion is slow and the effects of even very small observational errors may be considerable until observations covering several months are available. The delay in calculations and publishing an orbit of this most interesting body is therefore good evidence of the full comprehension which its discoverers had of the problem, as well as their excellent judgment.—*Cortina d' Ampezzo, Italy.*

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❡ Editor's Note: In the light of Professor Russell's lucid explanation of the standard method by which astronomers work out a new orbit, some notes on Pluto's orbit, by the astronomers Ernest Clare Bower and Fred L. Whipple of Lick Observatory, published in the August number of the *Publications of the Astronomical Society of the Pacific*, make interesting reading. These astronomers state that, between last January and June, more than 100 accurate observations of the orbital arc described by Pluto were made available by various astronomers, "but," they add, "these alone would not suffice were they not augmented by observations made possible by the identification of the object on plates taken before its discovery." This was because the January-June, 1930, observations would cover only about 1/500 of the full orbit—a pretty short arc from which to work out an accurate orbit. But at this juncture Mount Wilson, Yerkes and one other observatory came to the rescue with some old plates of the vintage of 1919, 1921 and 1927, which they had found in storage. With these "pre-discovery" observations the new arc now represented a span of 11 years or about 1/25 of the whole circumference of the orbit, a respectable base line from which to perform calculations. How closely Pluto now has been pinned down is shown by the fair agreement in the following results of various astronomers' calculations:

	By Bower and Whipple	By Nicholson and Mayall
Perihelion passage due	Feb 27 473,1989	June 5 5, 1988
Eccentricity of the orbit	0.253741	0.2575
Inclination of the orbit	17°8′57″	17° 09′
Period of revolution	249 1661 years	251 80 years

TELEVISION NEEDS NEW IDEAS—AND LESS BALLYHOO

The author

By A. DINSDALE, Assoc. I. R. E.

EVER since I reached the hospitable shores of the United States, nearly every person I have met has asked me: "Well, how long do *you* think it will be before we get television?" I never have felt any particular urge to assume the rôle of prophet, and it seems to me that prophesying about television is about as thankless a job as that possessed by the weather forecaster.

To begin with, it depends largely upon what you mean by television and what you expect it to do. In Europe the public, educated by a vast amount of advance publicity designed to boost somebody's over-enthusiastic claims, has acquired definite and rather high standards about television. It has heard so much about being able to "see the world from your own fireside," to watch the finish of the Derby or the final of the Cup Tie (England's star football match), that it expects just that. And as nobody so far is able to provide the necessary apparatus and service, the public has become somewhat apathetic. It has metaphorically rolled over and gone off to sleep again until something startling happens to wake it up. Extensive lecture tours have shown me that there is no lack of interest on the part of the British public, but much disappointment at the non-fulfilment of promises. "Hope deferred maketh the heart sick."

IN America the position seems to be rather more complicated. In the first place, there seems to have been even more ballyhoo about television over here than there has been in Europe. There are more people working on it, some earnestly and scientifically, and some not so scientifically, some with laudable aims, and some with aims not so laudable.

Since I arrived here I have talked with most of the leading workers in the field, and I can find no unanimity as to what television must be able to do. Dr. Alexanderson, for instance, thinks that a limited form of television will be sufficient, while Dr. Ives looks to the time when television will be able to do all that the talking movie can do, and as well. He contends, however, and I think quite rightly, that the system of television as developed by the Bell Telephone Laboratories for use in conjunction with the telephone, is quite adequate for the purpose. But that is a specialized application. The public expects broadcast television.

With television workers themselves at variance as to what television must be able to do, it is not surprising that the general public has no definite notions on the subject. At least, nobody seems to be able to tell exactly what the public wants or expects. Under these circumstances, the obvious thing to do would appear to be to give the public what you have, try to educate them into liking it, and keep on improving on it.

THAT television today is up against an impasse is a fact acknowledged by most authorities, although sporadic articles in the daily press would lead the layman to believe that television is soon to be ready for general use. This impression is fostered by interesting experiments on a laboratory scale which have been heralded as forerunners of practical home televisors. But even the best television equipment available today falls far short of the desired home radio-movie goal, and it becomes increasingly apparent that new paths must be beaten before present-day mechanical and electrical difficulties are overcome. The author of the accompanying article, formerly editor of *Television* (London), presents a point of view that is refreshing after the deluge of misleading publicity of the past few years.—*The Editor.*

The general public, however, will have none of the present limited form of television, which can show only a head-and-shoulder view of some distant speaker or singer, and that imperfectly. The fans, who love tinkering with something, have taken to it, of course, both here and in Europe, but commercial sets just cannot be sold. In England, the Baird Company's attempt to sell machines has met with but scant success. They blame the limited broadcast facilities granted them by the B.B.C.: 11 to 11:30 A.M. five days a week, and midnight to 12:30 A.M. two nights a week. But over here, where broadcast facilities are available on a more liberal scale, I am told that attempts to sell inadequate televisors are meeting with no better success.

The real reason for this failure is not far to seek, and is very simple. There is definitely no entertainment value in the present head-and-shoulder images. Realizing that fact, the Germans have made no attempt as yet to sell televisors; they are devoting all their energies to further experimenting.

THERE are some who disagree with me about the entertainment value of the present image, and point to the fact that something like 75 percent of a talking film is composed of close-ups. True, but the film shows more of the individual, more than one person at a time, has a lot more detail, and the producers have had years of experience with their medium of entertainment and have learned how to make it entertain. On the latter score the television people have reached the point where they say that "a new technique will have to be developed." Nobody knows yet just what form that technique will take. And at this stage they can not be expected to know.

Others who disagree with me contend that a start must be made somewhere, sometime, and point to the crudeness of the art of radio-telephony when sound broadcasting first started. It is difficult to compare two things which are totally different, but I believe that sound broadcasting, when it started, had more power to interest, entertain, and attract than has the art of television at the present time.

Just what the public expects of television is a question nobody can answer. Some go so far as to express doubt as to whether the public wants television at all! I think there can be no doubt that, after what it has been led to expect of television, any serious attempt to stampede the public into patronizing the present limited form of television will not only meet with failure, but will do the youthful art irreparable harm. Some harm has already been done.

Let us, therefore, survey the present state of the art from a technical angle. Let us create a standard of performance and see if present methods will permit of its achievement.

But let me make one thing clear before I proceed further. In reading over what I have written it would appear that I am a thorough pessimist, more of an enemy than a friend to television. Far from it. There is no doubt at all in my mind that television will ultimately arrive. It will eventually be able to do all that has been promised. Televisors will one day be as common in our homes as radio sets are today, and a television industry will grow to the proportions of the present radio industry.

But before all these things can happen we shall have to think up a few new ideas.

It is an extraordinary fact that television has not, so far, developed any brand new ideas for its own exclusive use. All its ideas and apparatus are either borrowed from some other field of scientific endeavor, or they have been in existence, but not made use of, for many years.

Take the scanning disk, for example. Invented by Nipkow in 1884, it lay idle until it was coupled with such modern inventions (taken from other fields) as the neon lamp, thermionic tube, and photo-electric cell, when television was produced. Nipkow could have done it in 1884 if he had had the use of these modern facilities.

THE large viewing screens of Jenkins, the Bell Telephone Laboratories, and Baird are reminiscent of the walls of selenium cells controlling distant electric bulbs, which were suggested by several early enthusiasts and actually constructed by Rignoux and Fournier in 1906.

The use of cathode-ray tubes was first suggested by Campbell Swinton in 1911, and they were experimented with soon after by Boris Rosing in Russia and Belin in France.

All these things have, of course, been vastly improved upon and made to perform incredibly well, thanks to modern facilities, but they have their limitations. What astonishes one is that all the present-known workers, knowing these limitations, are content to pursue the old methods. Some entirely new principle is needed, and needed badly. And it is quite on the cards that the present workers will get so stale and hide-bound that the new idea, when it does come along, will pop out suddenly and unexpectedly from a source never previously heard of.

Before we can proceed to an examination of the limitations of present television apparatus and methods, it is necessary to set forth some standard of achievement which must ultimately be met, and see how far toward that standard we can go with the means at present available.

Baird's large television receiving screen. The extreme complexity of devices of this nature is an important indication of the need for new ideas in the art

My guess is that television, for home entertainment purposes, will have to be capable of embracing a field of view, either indoors or outdoors, as extensive, complete, and flexible as is at present coverable by means of a motion picture camera, and the detail presented will have to be comparable with that of the motion picture also. After all, as an entertainment medium, television must go into direct competition with the motion picture, or couple up with it so that films can be distributed and simultaneously exhibited all over the country by television methods. It will displace the film for spot news, although the film will always be wanted for record purposes.

The home screen upon which the television images are depicted will have to be, for comfort and convenience, not smaller than nine by twelve inches, unmagnified. The magnifying lenses at present in use are undesirable for several reasons. Many of them are so badly designed and arranged that they distort the edges of the picture. Even if well arranged, they magnify all the defects in the image, cause loss of light, and, perhaps most important, limit the number of observers to two or three, and force even that number to locate themselves, often in discomfort, directly in front of the lens. The standard of comfort of the home movies must prevail on this point.

Having thus set the standards of field of view and size of screen, the next important step is to fix quantitatively the amount of detail which must be provided. Here it is necessary to guess a bit again. If scanning is to continue to be carried out in parallel strips or lines, my guess is that we shall have to provide 100 lines per inch. That means that, for a nine by twelve inch receiving screen, unmagnified, we shall have to resolve the image into 900×1200=1,080,000 picture elements. If we set the transmission speed at 15 images per second—a rather low figure—the frequency of the A. C. picture impulses which we must transmit, either by wire or by wireless, works out at

$$\frac{1{,}080{,}000\times15}{2}=8{,}100{,}000 \text{ cycles,}$$

or 8100 kilocycles.

WE are now faced with two major problems: (1) terminal equipment capable of fulfilling the above requirements, and (2) channels of communication which will successfully transmit frequencies up to 8100 kilocycles.

Let us consider terminal equipment first. Remembering that the circumferential distance between the holes of a scanning disk must be equivalent to the long side of the picture, in this case twelve inches, and that there must be 900 of them, we should require a scanning disk nearly 300 feet in diameter to fulfill the requirements set out above! And if we used a flat plate neon tube, we should need one with a plate measuring slightly in excess of nine by twelve inches, and such a tube would require a prohibitive amount of amplifier power to illuminate it. The whole conception is preposterous and ridiculous.

The Jenkins drum scanner provides no solution to the problem; it also would assume unwieldy proportions. There remains the Weiller mirror drum, which would require 900 mirrors, and if these were only one inch wide the diameter of the drum would be something like 25 feet.

That exhausts all known mechanical methods of scanning which have proved at all successful. It is obvious, therefore, that we must either relax our requirements for television or seek other and non-mechanical methods.

BEFORE the days of the thermionic tube, we achieved, or attempted to achieve, radio-telegraph communication by just such cumbersome "brute force" methods. Now we have thrown all our unwieldy machinery into the discard, and achieve our object a thousand times better by harnessing electrons. We shall have to discover some method of harnessing electrons to do our bidding in the television field. A stream of electrons travels with the speed of light, it is weightless and therefore inertialess, and it can be controlled electrostatically or magnetically.

The Weiller mirror wheel used in television scanning. For large images, this device becomes unsatisfactory

The fundamental essence of the television problem may be defined as the time element, or, if you like, speed; so much has to be done in such a limited space of time. As we have already seen, 16,200,000 picture elements have to be dealt with *per second.* Obviously, only electrons are capable of handling such a gigantic number within the time allowed.

The only electron device at present known which seems to offer a ready solution to the problem is the cathode-ray tube. It has been experimented with for many years, and several workers are still busy on it, trying to adapt it for both transmission and reception purposes. As at present made and used, the cathode-ray tube has many disadvantages. It is expensive, both as to first cost and as to auxiliary equipment and operation, its life is short, and there are still difficulties in the way of adequately controlling the scanning movements of the electron stream. It remains to be seen, therefore, whether the cathode-ray tube is the best practical embodiment of the purely electronic method of achieving television.

So much for terminal equipment.

Coming now to channels of communication, one is almost tempted to say that it will never be possible to transmit 8100 kilocycles over either a wire or a radio circuit. But in scientific matters today's impossibility is tomorrow's commonplace achievement. At present it might be possible to transmit such an enormous frequency by radio, but only on wavelengths below ten meters. Obviously we shall have to discover some new technique or principle in radio communication also. That it is already long overdue is evidenced by the fact that the entire spectrum of wavelengths used for all radio communication purposes is already full to overflowing; radio communication cannot develop any further until it is released from its strait-jacket. Personally, I think the new principle discovered by Dr. J. Robinson of England, and incorporated in the Stenode Radiostat receiver, will not only solve the overcrowding problem but also make it possible to transmit the enormously high frequencies required for television.

That is my conception of the problem of television as it stands today. A gloomy picture, you may say. Or again you may ask me: "How long will it be—?" As I said at the outset, I am not going to be inveigled into prophesying, but I feel very optimistic about the future development of television. It is clear that much remains to be done, and it is equally clear that television is going to provide yet another example of the survival of the fittest. So much remains to be done that only those who are backed by almost unlimited resources in the shape of money, brains, and laboratory facilities stand any chance of winning through and reaping their reward.

The work which has been done to date, and about which there has been so much ballyhoo, must be regarded in the light of a preliminary canter over the course. Already there is evidence that the most serious contenders in the race for television are abandoning present methods and working quietly behind locked doors on something different. In Germany, Dr. Karolus, working in conjunction with the Telefunken Company, has been silent, but not inactive, for a year.

IN this country, the television staffs of the General Electric and Westinghouse companies have just been concentrated in the R. C. A.-Victor plant at Camden, New Jersey. That the R. C. A. group really means business is evidenced by the utterances of its executives, and if further evidence is required of the imminence of television on a really commercial and entertaining scale, there is the projected 250,000,000-dollar Rockefeller radio city which Merlin Hall Aylesworth, President of the National Broadcasting Company, says is to be built around television. It is estimated that this building will be ready in three years, and that is as near as I will go to prophesying when television will be ready to make its bow to the public, not in so perfect a form as I have outlined as being ultimately necessary, but at least some way towards it.

And finally, I have been asked who will win the race, Europe or America. Well, one of the essential qualifications of the competitors, mentioned above, has to do with financial resources, and America has more money to spend on television than has Europe, and America seems to be more determined. So with that I will leave the American workers to it, and wish them the best of luck.

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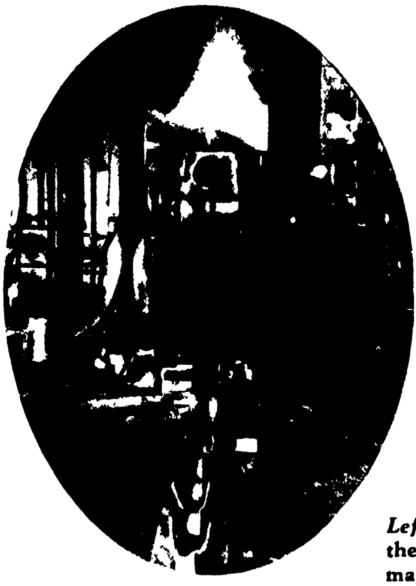
¶ *Editor's Note.* Although we are in hearty accord with Mr. Dinsdale in the general tenor of the foregoing article, we can not help but take exception to the statement ending at the top of this column. There are thousands of amateurs in this country who are learning the fundamentals of television by experimenting with their own equipment. And it is well known that the radio amateur is never content to follow the beaten paths. His record in the development of the short waves justifies this statement, and we do not feel that we are too optimistic when we express the opinion that the ranks of amateur radio will contribute some of the new ideas needed for the development of television.

GLASS TUBING BY THE MILE

THE old method of making glass tubing by blowing, while the hollow cylinder was pulled out and cooled, was an exceedingly crude process and the variations in the size of the bore were great. Now, however, by the aid of cleverly designed machinery, although under the principles of the archaic methods, glass tubing is made by the mile. The machines operate continuously, drawing the molten glass from the furnace, cooling it at a distant point and cutting it off in pre-determined lengths, automatically, by a special mechanical device. In this method, as in the hand process, there is a long line of easily broken tubing in constant motion between the blow-pipe and the far end where the cutting operation takes place.

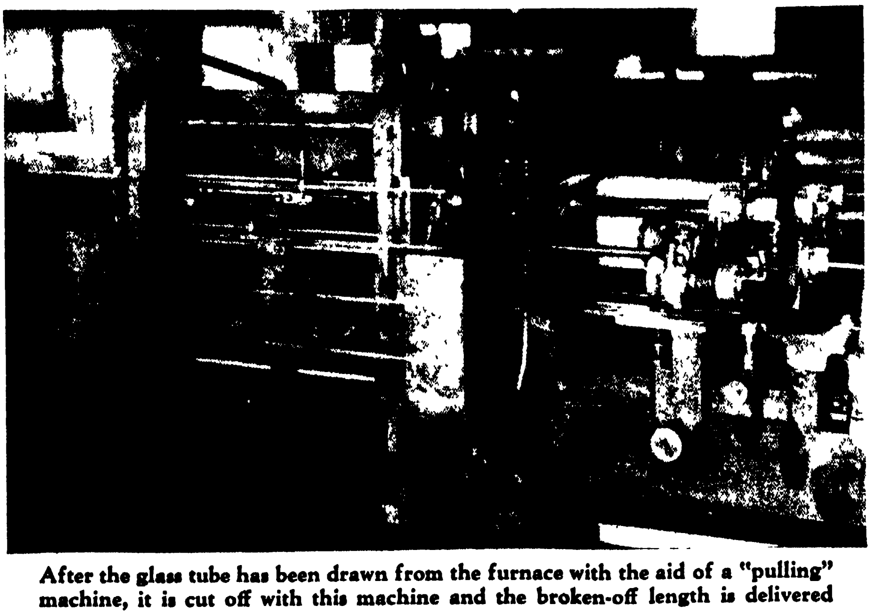
View of the rear of the glass melting furnace

A tank furnace supplies a steady stream of molten glass. As the viscous glass flows to the aperture, it is kept very hot by the glass blow-pipes. The glass forms a tube over a hollow mandrel by the aid of air which is forced through it. The air pressure is slight, being only one or two ounces per square inch. If this air should be cut off, a cylinder of solid glass would form. After the tube is formed comes the drawing process which is dependent on a machine which pulls away, continuously, the rapidly cooling tubes of glass. Two endless chains serve to carry pressure plates which grip the tube without fracturing it. The motion is positive and in one direction. The cooled tube is drawn away from the furnace, dragging away more of the molten glass which is to form the tube over the hollow mandrel which purveys the air for blowing. The machine is dealing with a very peculiar substance and the slightest tendency to buckle up would fracture the tubing. The speed of the pulling chains may be adjusted at will.

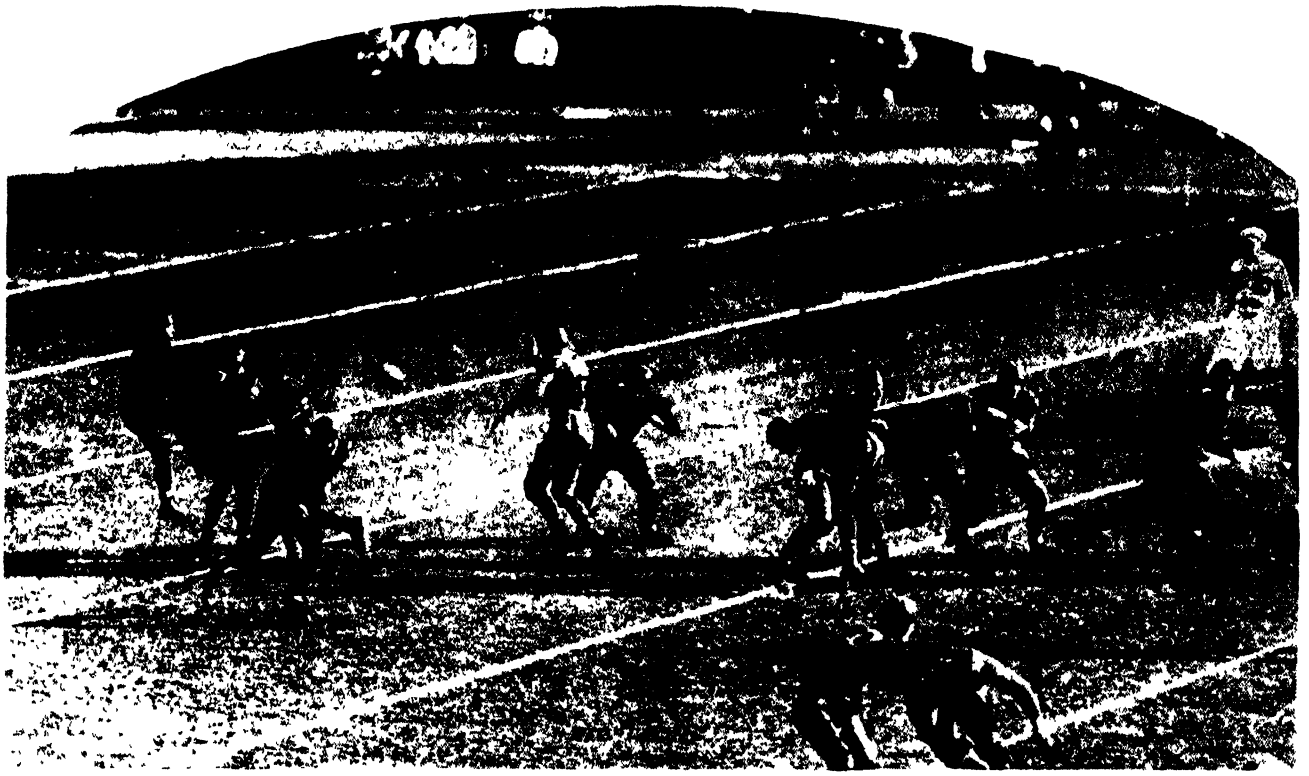


***Left:* Discharge end of blow pipe from which the glass is drawn. *Right:* Heater muffle and mandrel forming the continuous glass tube**

The pulling machine is supplemented by a device for breaking off the tube in pre-determined lengths as it is pulled along. After the tube leaves the endless chains it encounters a second set of guide-rolls mounted on vertical spindles. Next it passes over a pressure table which yields vertically. Then it enters a part of a special wheel and is broken off to the proper length. This length is finally delivered from the machine for inspection and packing. The cutter wheel co-acts with the pressure table. That is to say, the cutter wheel moves downward and comes into contact with the work at the beginning of its own stroke. The cutter wheel cuts a surface groove on the glass. It is not designed to effect a complete severance of the glass but to make a point of weakness. A second wheel revolves intermittently and exerts a transverse pressure against the work at a point in advance of the cut, thus breaking it off at the groove. The demands for uniform glass tubing, in science and industry, are many.


After the glass tube has been drawn from the furnace with the aid of a "pulling" machine, it is cut off with this machine and the broken-off length is delivered

We are indebted to the Libbey Glass Manufacturing Company of Toledo, Ohio, for permission to inspect the interesting process.



The Army blocks a Notre Dame punt in their famous 1929 game

HOW MANY MINUTES OF PLAY IN THE AVERAGE FOOTBALL GAME?

By HUGO L. RUSCH

Supervisor Technical Data Section, Johns-Manville Corp.

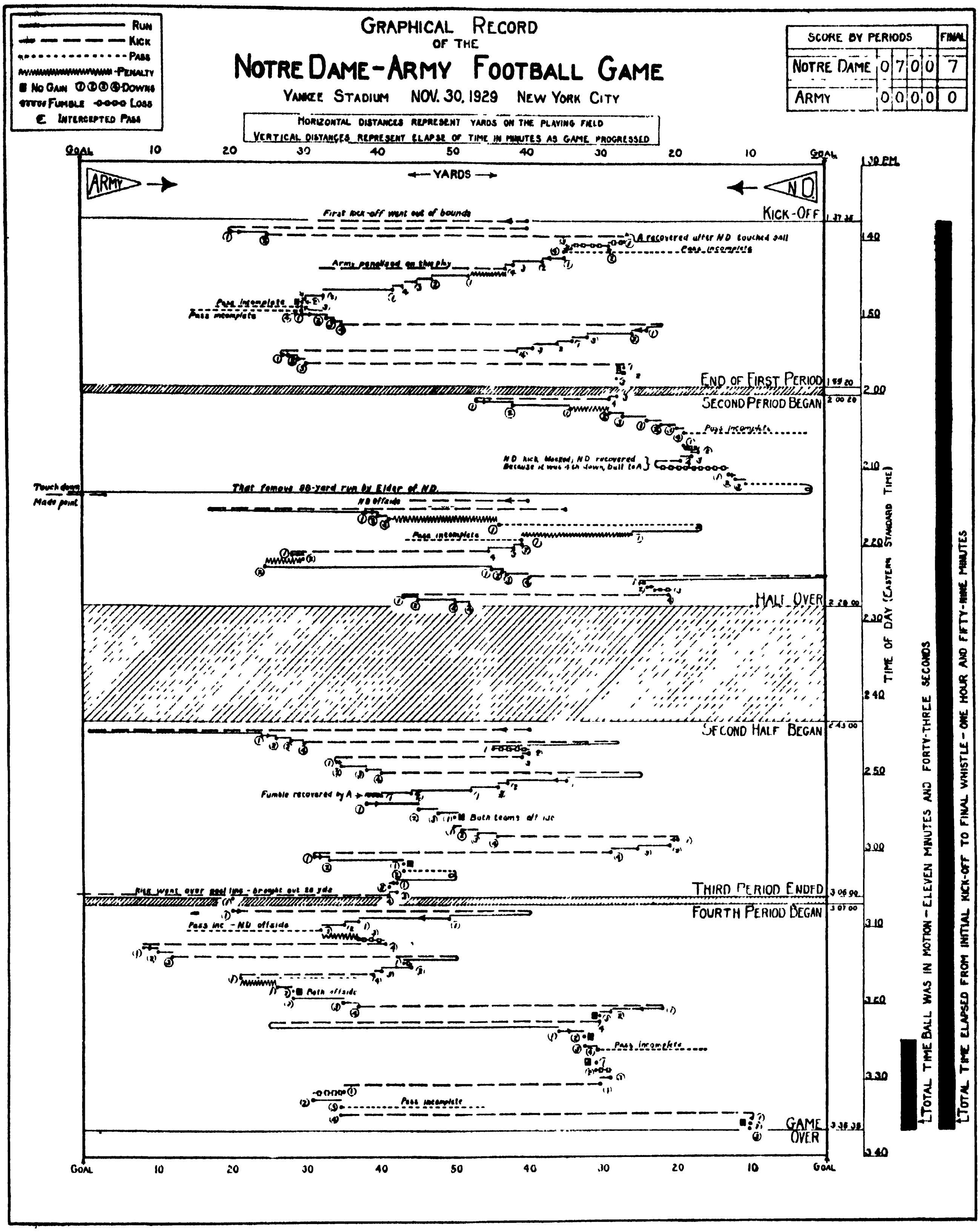
YOU pay at the rate of $24.25 per hour to watch football! It costs hundreds of thousands of spectators this amount for their amusement every autumn. The time the ball is officially in motion during an entire game—clocking each play with a stop-watch from the instant center snaps back the ball until the end of the play—totals the astoundingly short period of about 12 minutes. To be exact, the actual playing time in eight important games during the 1927, 1928, and 1929 seasons in which Notre Dame, the Army, Yale, Harvard, Princeton, Stanford, Ohio State, Columbia, Indiana, and Syracuse participated was an average of 12 minutes and 22 seconds per game. With your ticket costing you five dollars you paid at the rate of $24.25 per hour. If you were able to buy a ticket for three dollars, your hourly rate was only $14.55. If you were one of those spectators who paid sixty dollars a pair for the coveted pasteboards, figure out your own rate per hour.

The official playing time of one hour—four quarters of 15 minutes each—includes time for signals, formations, and shifts. The rest period between the first and second quarters, and the third and fourth quarters, is one minute; the time between halves is 15 minutes. Including periods for "time out," the total lapse of time from the initial kick-off to the final whistle, for the eight games mentioned, averaged 2 hours 20 minutes and 9 seconds.

TAKE the case of the Army-Notre Dame game at the Yankee Stadium on the last day of November, 1929—the game in which Elder of Notre Dame thrilled 83,000 spectators and many more thousands of radio listeners, when he intercepted one of Cagle's passes and ran 98 yards for a touchdown. For this game, many folk arrived half an hour before the kick-off and people were still leaving the stadium more than an hour after the final whistle, which blew 1 hour and 59 minutes after the kick-off. Hence some spectators spent about 3½ hours at the field to see the ball actually in motion less than 12 minutes (to be accurate, in this game it was 11 minutes and 43 seconds).

The time studies of the eight games proved that the period the ball is in motion during each play averages only 4½ seconds. This is based on a total of 1328 plays, all of which were carefully timed with a stop-watch reading to tenths of a second. As might be anticipated, some of the plays lasted four times as long as the average. And it was indeed apparent that the amount of spectator excitement was in proportion to the time the ball was actually in motion. The spontaneous cheers and yells were all concentrated in these very short intervals and all eyes were figuratively glued on the field.

On November 30, 1929, at the Yankee Stadium, in the second quarter, the Army had blocked one of Notre Dame's punts but Notre Dame recovered the ball. Since the play was on the fourth down, the ball went to the Army on Notre Dame's 13-yard line. Things looked fine for the Army. Two plunges by Cagle and Murrell netted a few yards, and then Cagle whisked a delayed pass over the left side of his line. Elder of Notre Dame rushed in boldly and, instead of playing orthodox football for a goal line defense and knocking the ball to the ground while covering receivers of the pass, he snatched



GRAPHICAL RECORD OF THE NOTRE DAME-ARMY FOOTBALL GAME

YANKEE STADIUM NOV. 30, 1929 NEW YORK CITY

SCORE BY PERIODS					FINAL
NOTRE DAME	0	7	0	0	7
ARMY	0	0	0	0	0

the ball from the air on his two-yard line, lost a precious split-second in regaining his balance, and then tore madly up the side line. Two Army men dove for him but missed—by a few inches. He ran unmolested until he reached the Army's eight-yard line when another West Pointer failed—by inches—to catch his elusive prey.

The fleet Elder raced over the goal line for a touchdown. But no one knew then that he carried the game with him. Carideo booted over a placement for the extra point, ending the scoring for the day. The crowd had been held spellbound. For 18½ seconds—the time of that play—they forgot the bitter cold. It was the longest play recorded in the eight games analyzed.

In the Army-Stanford game at the Yankee Stadium on December 1, 1928, there was another long play. Here also Cagle had a hand in it, but this time he did the carrying. The Army had the ball on their own 34-yard line. It was snapped back several yards to Cagle, who made a dazzling zig-zag run through the entire Stanford team, dodging tackler after tackler, to Stanford's 44-yard line for a net gain of 22 yards. It was a thriller. The play lasted 15½ seconds, the longest play of the game, and second longest in the eight games at which the time studies were made.

In the play which ranks third in point of time out of 1328, the performance of Christian Cagle of the Army is again encountered. This time it is in the Yale Bowl on October 22, 1927. With the ball on Yale's 48-yard line, Cagle received it about 12 yards back of the scrimmage line, and, by avoiding and throwing off Yale tacklers, down on his knees and back up again but never completely stopping, he carried the ball on another brilliant run of over 32 yards to Yale's 28-yard mark for a net gain of 20 yards. The total time of this play was 11½ seconds—11½ seconds bristling with thrills and gasps.

The average play in football—about 4½ seconds—hardly gives the spectators time enough to work up to a state of excitement. It remains for the long plays, such as the kind just described, to give the greatest thrills. It is these long plays that we like to see and read about. During each second of actual play the suspense is tremendous, and this is what really makes football the game it is for the spectators.

WITH the exception of the unusual plays such as those described, the punts consumed the greatest amount of time. They averaged about nine seconds, and the straight line plays three seconds. The average forward pass, counting those completed and also the incomplete, averaged about six seconds. The adoption of the pass has helped to spread the players more, and has served to increase the average time per play, thereby increasing the period of suspense and true excitement. Hence this change was a most important one from the spectator's standpoint—the standpoint that made half-million dollar gate receipts per game possible. Years ago the spectator saw little more than two struggling groups of 11 men each, pushing up and down the gridiron. The object was sufficiently apparent, but not the method of attainment. Consequently the game's power to draw paying spectators was not at its present height.

But what of the fact that the total time the ball is in motion during an entire game is only about 12 minutes? Shall we establish rules which will double or triple this period—the time during which the players are giving their every ounce of energy and the spectators are really getting the excitement they crave? No, it would not be wise to do so from either the spectators' or players' standpoint. Have you ever noticed that you are quite tired at the end of a football game, and particularly so if you are keenly interested in the outcome? As the ball moves back and forth on the field, you unconsciously push in the direction you would like to see the ball move. When the losing side cuts the air with "Hold 'em" they are unconsciously pressing their shoulders against an imaginary wall.

Students of public speaking and oratory tell us that a speaker who gets his audience extremely interested not only sways them mentally but also physically. It is said that the entire group of spectators at a football game actually moves with or against the ball, and by careful observation these waves of motion can be detected. Therefore, even though you may be paying at the rate of $24.25 per hour to see actual football, perhaps it is best for you that there is only 12 minutes of it. If you kept this tension steadily for an hour, you might have to be carried out of the stadium.

Cagle takes the ball

And now from the player's standpoint. A man running the 100-yard dash in 9-3/5 seconds is expending energy and moving at a rate which he could not maintain for 30 seconds. He would become so fatigued, if he tried it, that his pace would slacken before he traveled 300 yards. So it is on the gridiron. The men are giving every ounce they have, while a play is being executed, and it is undoubtedly good that the time per play *is* only a few seconds. Under the present rules, the players—all of them who have played hard—are usually nearly exhausted when the final whistle blows. The law of fatigue holds for everyone, regardless of his physique; the time for fatigue to take effect varies, of course, in the individual.

Consider the wear and tear upon human endurance during the game, when men line up for action 140 to 180 times. Little wonder that a rugged physique and heroic courage are required of the players. Hence it now can perhaps be better understood why, toward the end of a game, some of their performances are not quite up to standard.

Scientists tell us that when a muscle is stimulated, lactic acid is liberated in certain parts of the muscle. As this stimulation continues, an alkaline solution neutralizes the acid, which tends to relax the muscle. The process can continue until the available supply of alkali for neutralizing the acid is depleted. Then the excess acidity of the muscle stops its further activity and a state of complete exhaustion has been reached. Our whole voluntary muscular movement depends on this chemical reaction with lactic acid. There is a very definite limit to the extent any individual can use his muscles before complete exhaustion sets in.

The best way to win a mile run is to continue at a pace which will just produce exhaustion at the tape. If the pace is raised beyond this point, untimely exhaustion is certain to take place and the race is lost. Naturally, the longer the race the slower will be the average speed for each individual. Consequently, if the present rules and method of playing football results in near-exhaustion of the players at the end of the game, a change in the rules so there will be more actual playing time, without increasing the total time between the initial and final whistles, would mean a slackening of the speed and deftness with which each play is executed. Such a change would certainly not improve the game for the spectators.

A STUDY of the tabulated results of the eight games, with the number of plays and the time elapsed, provides some very interesting and instructive data. The number of plays per game averaged 166. The average number of plays per quarter varied between 40 and 43. This indicates that the proposed plan to play the game on the basis of 40 plays per quarter, in place of a definite time interval, will give us just as much football per game as at present. And, according to Mr. Harry R. Coffin of Harvard and other advocates of the new system, there are some very definite advantages. They claim the suggested period-by-play method has the following merits:

(1). It will eliminate the frantic use of the forward pass by the losing team during the final minutes of play.

(2). It will do away with any possibility of suspicious timing by officials.

(3). It will increase the interest of the spectators.

This system of playing was employed in the game between Brown University and Boston University in Providence on November 7, 1925, in which Brown won easily, 42 to 6. The consensus seemed to be that the score was too

(*Please turn to page* 411)

A member of the *Scientific American* staff also visited Glozel, as did the author of the accompanying article, and made this and other photographs. According to one account the original "discovery" at Glozel was made while the young farmer, Emile Fradin, was plowing with cows. By chance, on the day of the visit, one of the Glozelians likewise was plowing with cows and within a few feet of the famous discovery site, which was at left just out of the picture

THE STORY OF GLOZEL—A CHAPTER IN CREDULITY[1]

By DAVID RIESMAN

Professor of Clinical Medicine, University of Pennsylvania

THOSE who have read something about Glozel may wonder why I speak of it here. Is it not a dead issue? No, for as a study of human credulity and as a commentary on the hot-headedness (or should I say pig-headedness?) of many men of science it will always occupy a prominent place in the history of civilization.

Although many are probably familiar with the main facts, I want to give a brief synopsis of the involved story. I say "story" advisedly for from the very outset the mystery of Glozel has formed a fascinating tale; very much in the genre of our best thrillers, with plot and counter-plot, gum-shoe detectives, and all the pertinent paraphernalia.

Glozel is a small hamlet of four farmhouses, about 15 miles from the famous French spa of Vichy. Emile Fradin, then a youth of 18 and belonging to an old local family, was one day working in his grandfather's field when a cow suddenly slipped into an unsuspected hole. Fradin went to investigate and found that the hole led into an oval pit containing a variety of remarkable objects—bricks, tablets, vases—which he gathered and as soon as possible showed to the village school mistress, Mlle. Picandet. The latter in turn showed some of the tablets to M. Clément, a school teacher in la Guillermie.

EVENTUALLY the news of the discoveries came to the ears of Dr. Albert Morlet, a surgeon of Vichy and an amateur archeologist. Thereafter Dr. Morlet and Emile Fradin together began to excavate at Glozel and brought to light more and more buried objects which they collected in grandfather Fradin's house and which Dr. Morlet described in detail in an endless series of articles in a literary journal, the *Mercure de France*. It was through this magazine—the *Atlantic Monthly* of France in more senses than one—that I became interested in the Glozelian discoveries. My interest was especially aroused by the claim of Morlet and others that an alphabet had been discovered at Glozel which antedated every other alphabet then known. I therefore decided while spending a vacation in the Auvergne to see Glozel for myself, but before doing so I determined to interview Dr. Morlet in Vichy.

At first he suspected me of being an archeologist but when in answer to a direct question, I denied the soft impeachment and proclaimed myself merely a doctor, he became cordiality itself and showed me his collection of Gallo-Roman and Glozel antiquities. He told me that he as well as others had been inclined to consider Glozel as belonging to the Magdalenian age because of the presence of harpoons and of stones engraved with reindeer and other animals long extinct in France, but further studies had led to the conclusion that Glozel was Neolithic. Dr. Morlet kindly asked me to

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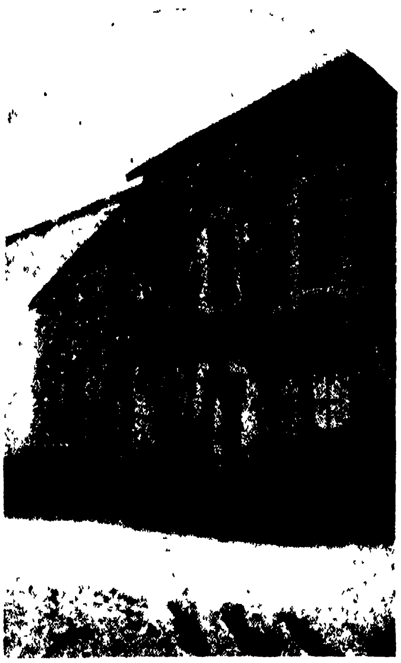
[1] Presented before the American Philosophical Society.



The little museum in the Fradin farmhouse. The crude sign mentioned by the author shows over the doorway. The picture was taken by a *Scientific American* staff member while perched on an "island" in the nearby manure-pile-quagmire, an entity which provides the cheery aspect from the typical French farmhouse. To see the exhibits he paid a few francs, as did the author of the accompanying article and, like him, was watched every instant by one of the Fradins; like a cat watching at a mouse-hole

stay over until the following day and dig with him and Professor Bjórn of Sweden, but I was unable to do so.

After leaving Morlet I motored, together with two American friends, to Glozel. Emile Fradin received us and at once offered to take us to the field of excavation. It was at the bottom of a deep ravine and was surrounded by a barbed wire fence. He showed us the original oval pit and the two tombs subsequently discovered. As it was raining hard and as the clayey ground was slippery, I declined his invitation to crawl into one of the tombs but asked instead to see the Museum. After paying two francs each we entered through a low door above which was a crude sign with the pretentious words, "Musée de Glozel," and found ourselves in a square low-ceilinged room with shelves on the walls and very primitive glass cases standing on the floor. The objects exhibited on shelves and in cases were astounding in number and variety—vases, tablets, engraved stones, ornaments (especially pendants), some pieces of glass, and harpoons, the last not nearly as artistic as those of Magdalenian age I had seen in Les Eyzies and at Laugerie-Basse.

Three articles attracted my special attention—vases or vase-like pottery ware having eyes, nose, and ears but no mouth, which Morlet has called death masks, explaining the absence of the mouth by assuming that the primitive makers wanted to express the silence of the grave. Secondly, a squarish object suggesting the female figure with a cylindrical projection from the forehead interpreted as the phallus—this Fradin told me was a bisexual idol; and most striking of all, clay tablets with graven signs looking in every way like alphabetical characters. I was struck by the clean red color of these tablets. When I spoke of this to Fradin, he explained it by saying that the soil in which the tablets had been found was such that it did not readily fuse with the clay and hence was easily brushed off. There were also some large casts of the human hand which differed from the imprints of the hands in the Spanish and French caves in having all the fingers present.

I offered to buy some of the articles, especially a tablet, but Fradin resolutely refused to sell. During the whole of our stay in the Museum, the grandfather stood silent and motionless in a doorway leading to an inner room.

The reputed discoveries of an alphabet dating back to Neolithic times, of which I had now seen the alleged evidence in abundance, created a tremendous sensation in informed circles. Altogether about 136 characters had been distinguished, representing every letter of the alphabet except the letter B.

Hitherto the credit for creating an alphabet had been given to the Phoenicians but the oldest known Phoenician record, found at Byblos a few years previous, dated back only to about 1300 B.C.; Sir Arthur Evens' baffling Cretan inscriptions to about 3000 B.C. If Morlet and those who agreed with him were right, then Glozel was truly what M. Reinach called it—one of the greatest archeological discoveries of all time.

ALMOST immediately after the first appearance of Morlet's reports, doubts began to be voiced about the authenticity of Glozel, though in the early period of the controversy there were perhaps as many scientists who accepted the discoveries in good faith as there were doubters. Soon the pro- and anti-Glozelians became personal and attacked each other with a vituperative vehemence and a destructive sarcasm for which the French language appears to be the ideal medium. Reputations were shattered, old friendships broken, and as one of the French dailies remarked—even butcher boys came to blows on the streets of Paris. In fact Mrs. O'Leary's cow did no greater damage to Chicago than Fradin's to the reputation of some French savants.

Before long the leading French pre-

Herbert photo

The principal, Emile Fradin, about 21 years of age at the time the site was investigated by the Committee. Although a humble peasant he had done better than average in school; he also was artistic and had done water color paintings. Perhaps it was a coincidence that the Glozel forgeries improved in technique from time to time as the schoolmaster Clément loaned Emile different pieces of literature on prehistory. The output of discoveries also corresponded with books given him by other interested dupes; it even accommodated itself in nature to the hopes and objections they expressed. Oddly, all periods of prehistory were represented by the objects discovered, from the Old Stone Age to historic times, and it is another coincidence that the illustrated textbook of prehistory in Fradin's possession covered the same scope. Picture taken in the museum historians with only an occasional exception began to deny the authenticity of Glozel and to declare the excavated articles to be forgeries. A number of Englishmen were likewise unconvinced. However, Dr. Foat, a London scientist, makes the categorical statement that "if the finds of Glozel are not authentic, it is equally necessary to consider as false all that I have seen in museums between London and Constantinople." Several Scandinavian, Belgian, and Portuguese scientists also supported Dr. Morlet, and a German, Dr. Wilke, in a recent article enthusiastically upholds the standard of Glozel.

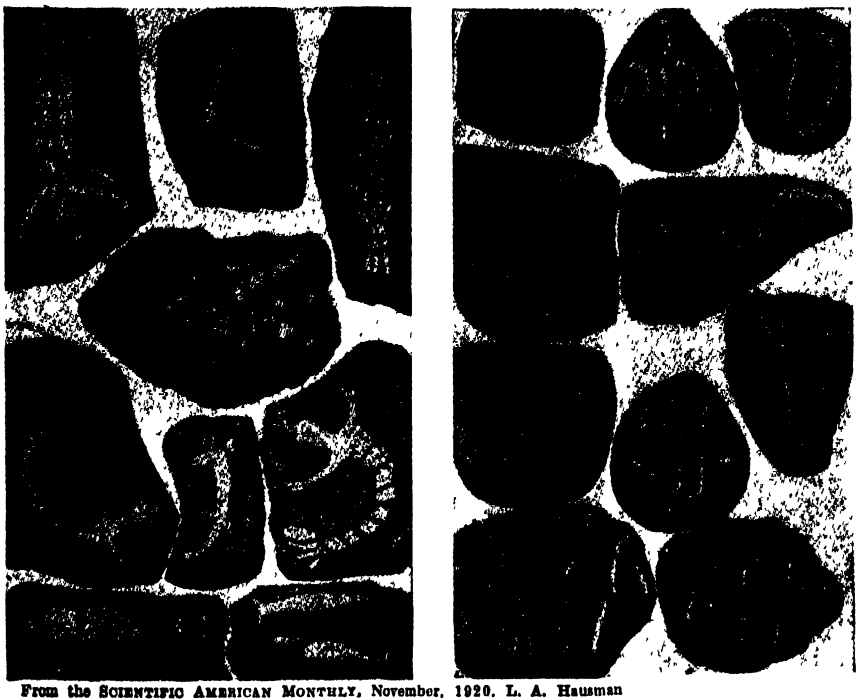
Scientific American staff photo

The actual site of the famous finds, at the lower end of a steep field above the valley of the Vareille stream. An attractive setting. The barbed wire fence around the site shows in the picture. It is easy for the tourist to reach Glozel; one goes to Vichy, where there are fine hotels, and hires a car to nearby Glozel

ARE Dr. Morlet's supporters right or is Glozel but one more of the long series of frauds that history recounts since Jacob imposed upon his father Isaac? Many will come to your minds—Thomas Chatterton, our own Dr. Cook, Constantine Simonides, the pretended author of the *Codex Sinaiticus*, the forger of the Mecklenburg Declaration, the Lincoln love letters in the *Atlantic Monthly*, the Tiara of Saitapharnes, and countless others.

One of the most interesting cases and the one having the greatest analogy to Glozel, if Glozel be a fake, is that of the so-called "Figured Stones of Würzburg." In the first half of the 18th Century there lived in Würzburg, in Bavaria, an ultra-pious physician named Johann Bartholomaeus Adam Beringer. He is not remembered for any great discovery or contribution to science, but for his share in a remarkable scientific hoax. At the time in which Beringer flourished an active discussion was going on as to the source and meaning of fossils. Although Leonardo da Vinci had understood their true nature—even Herodotus, 400 B.C. had a correct idea—the scientists of 200 years ago accounted for them as the result of "stone-making forces" of "formative qualities" or as growths from seeds. We may be inclined to smile, but with Dayton in Tennessee to chasten us, we can not throw stones at the Wurzburg of two centuries ago nor at the Sorbonne which a hundred years later deprived the great Buffon of his chair because of his heterodox theories.

Beringer had committed himself publicly to the belief that fossils were the capricious fabrication of God, hidden by Him in the earth for some inscrutable purpose. His zealous maintenance of this fundamentalist position led some of the students, together with members of the faculty and wags of the town, to make numerous "fossils" of clay which they buried in the side of a hill where they knew the Professor was wont to search for specimens. Beringer, chancing upon these objects, was completely deceived. The jokers became bolder and buried the most extraordinary and extravagant figures their whimsical imagination could suggest. They fashioned tablets bearing inscriptions in Hebrew, Babylonian, Syriac, and Arabic, and buried them not far from the original spot. Beringer was overjoyed to find such abundant confirmation of his doctrines and forthwith in true German fashion proceeded to write an exhaustive treatise.



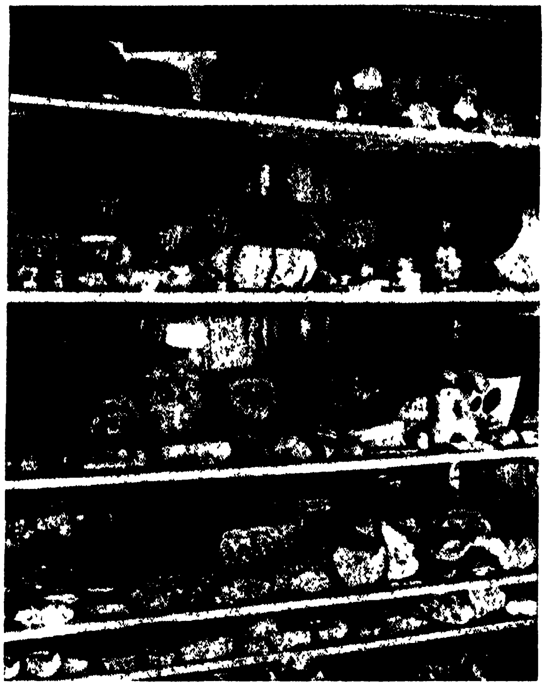
From the Scientific American Monthly, November, 1920. L. A. Hausman

Some of the famous Beringer fakes

THE wags now began to realize that they had gone too far. They expostulated with him and even told him the whole truth. Instead of believing them Beringer became more than ever convinced that the story his frightened colleagues told him was a ruse to rob him of the honor of his discoveries. No one could stop him. At great expense he published in 1728 the "Lithographiae Wirceburgenses."

Only too soon the shout of laughter with which the book was greeted brought the truth home to him. In chagrin and despair he exhausted nearly his entire fortune in a fruitless endeavor to suppress the edition and to buy up the copies already issued. He died soon afterwards, it is said, of a broken heart.

Is Dr. Morlet, like Johann Beringer, the victim of deception? Upon me personally he made the impression of an honest man. In certain quarters he was accused of fraud, for example, by the "Journal des Debats" and by the French Society of Prehistory. He promptly brought suit against them and won a



Herbert photo

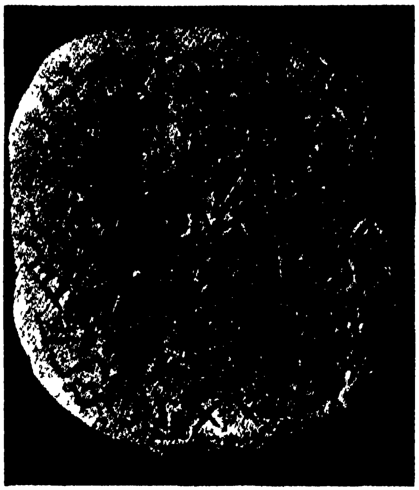
Exhibits in the museum of Glozel. Some are pots having eyes, nose, and ears but no mouth, as Dr. Riesman relates in his article. The "idol" to which he refers may be seen. Most of the objects in this picture are of pottery but the other finds have a wide variety— engravings on bone and stone, chipped flint and bone artifacts, and so on, representing a prodigious amount of industry on the part of (?)

verdict of 1000 francs damages. The defendants carried the case to the Court of Appeals at Riom, the native town of Willa Cather's lovable archbishop. In confirming the verdict, the Court gave expression to an amusing quibble. It held that Morlet, being a surgeon by profession and only by avocation a prehistorian, was not injured in the eyes of his real colleagues but only as an amateur archeologist. But as the defendants had not actually proved fraud, they were declared guilty though the fine was reduced to one franc and costs.

ANOTHER humorous episode might be mentioned. Regnault, President of the French Society of Prehistory, sued a Monsieur X because he, Regnault, had been compelled to pay the sum of four francs to see a collection of fake objects. As part of this legal action, the police of Moulins broke into Fradin's premises and took away a number of objects which were afterwards submitted to the public expert, M. Bayle. The latter reported that the tablets were of recent manufacture. Pieces of clay from a tablet crumbled readily in water; hence it was not conceivable that the tablets could have resisted the moisture in the ground had they been there for many years. Furthermore, a bit of grass picked out of a piece of earthenware showed under the microscope the vegetable cells, and some of the bone instruments still contained marrow. Bayle was soon afterward shot to death by one Philopponet against whom he had testified in court.

The Fradins themselves brought suit against M. Dussaud, member of the Institute, who in a trenchant brochure had called them fakers.

Let us now delve a little more deeply into this mystery so that we may understand better the basis of the controversy. The first serious doubt as to the authenticity of Glozel was based on the heterogeneity of the articles in Fradin's museum. How could one explain the presence of so many disimilar and unrelated objects—the 2000 or 3000 at the time of my visit have now grown into 5000 in one small field of excavation. No other archeologic site offers a parallel.



From "Glozel" by Dr. A Morlet

One of the many inscribed tablets. After a fancied resemblance to the old Phoenician alphabet was mentioned the subsequent "discoveries" oddly came more and more to resemble Phoenician. Later, M. Bayle, the "Sherlock Holmes" of France, found minute strands of cotton colored by aniline dye in one of the clay objects. Perhaps, however, the apologists for the Glozel incident would say this proved that Neolithic man of Europe (5000 to 11,000 years ago) understood the synthetic chemistry of dyes

Morlet answered this by saying that Glozel was a *Champ des Morts*, a cemetery; and that, as among many primitive peoples of later times, everything belonging to the dead had been buried with him. C. Jullian, who considers Glozel a Gallo-Roman station, accounts for the multiplicity of objects by the assumption that Glozel was a sorcerer's sanctuary. He has added greatly to the gaiety of nations by attempting a full translation of the inscribed tablets from the published illustrations. Dr. Morlet showed me with much amusement a crack in one of the tablets which Jullian had translated as a character.

Aside from the puzzling complexity of the collection, it has been pointed out that the tablets first exhumed bore fewer and less perfect characters than the later ones. Further, as soon as some one had made a criticism, the objects next exhumed were free from the criticized defect. Quite often certain features appeared that could be traced directly to scientific articles published shortly before. These facts seem, of course, very significant. Moreover, the scratches on stones, whether representing animal figures or alphabetic characters, were without the patina covering other parts of the stones, suggesting a recent production. Much was made of the penetration of roots into vases or tablets; but upon examination these roots were not found to be properly fossilized, which would have to be the case had the objects been in the ground for long ages. The utensils—harpoons, hand axes, scrapers—are far less artistic than those in other Neolithic stations. Vayson de Pradenne and Abbé Breuil indeed contend that none of them could ever have been used.

DR. MORLET and his chief supporter Van Gennep did their best to answer all these objections. The former at the height of the verbal battle-royal made a request for a governmental commission which was speedily granted, but when he found that a bitter anti-Glozelian, the well-known archeologist Capitan was a member, he objected and the Commission was never sent. Eventually, at the International Anthropological Congress at Amsterdam an International Commission was formally appointed to investigate Glozel. The Commission consisted of Absolon, Director of the Archeological Museum of the State of Moravia; Bosch Gimpera, Professor in the University and Director of the archeological work of Barcelona; the Abbé Favret; Forrer, Director of the Prehistoric and of the Gallo-Roman Museum at Strassburg, Miss Dorothy Garrod, Member of the Royal Anthropological Institute and of the French Prehistoric Society; Hamal-Nandrin, Lecturer on Prehistory in the Museum of Liège; Peyrony, Director of the Museum of Les Eyzies; and Pittard, Professor of Anthropology in the University of Geneva. Absolon was prevented from taking part in the work of the Commission.

After spending three days at the site the Commission issued a unanimous report which was kindly sent to me by Miss Dorothy Garrod. This report states unequivocally that the articles are for the most part of recent manufacture and have undoubtedly been planted in the ground by some one whom the Commission does not name; and that Glozel is neither prehistoric nor authentic. Vayson de Pradenne in a devastating brochure in which he declared the Glozel finds fakes, also accused no one by name but put the blame upon the "Esprit de Glozel;" in other words upon a fairy.

ONE might think that with the leading French, English, and American scientists—Peyrony, Pradenne, Abbé Breuil, Sir Arthur Evans, Dussaud, and, I believe, Professor MacCurdy—arrayed against Glozel, and with the destructive judgment of the International Commission, Glozel would cease from troubling the scientific and the lay mind. Though all due obsequies have been performed, Glozel refuses to remain in its sepulchre, and the literary battle continues. Dr. Morlet constantly sends me newspapers and pamphlets[2] and a distinguished pro-Glozelian of Belgium, Professor Tricot-Royer, has just supplied me with his defense of Glozel which is particularly interesting because Professor Tricot-Royer was present during the visit of the International Commission.

What keeps Glozel alive? First we have the fact that when men take sides in print they are loathe to recant, fearing ridicule—the more untenable their position, the more stubborn their resistance.

Secondly, six months after the International Commission's visit Dr. Morlet called together a Comite d'Etudes consisting of Dr. Foat, Bayet, and Tricot-Royer of Belgium, Reinach, J. Loth, W. Loth, Van Gennep, Deperet, Ajcelin, Roman, Audollent of France, and Soderman of Sweden; all sympathetic to Glozel. At their meeting they pronounced unanimously in favor of its genuineness.

Another reason is found in the attitude of a group of French and German scientists who are opposed to the traditional belief that *ex oriente lux*—that civilization is of oriental origin. The alleged Neolithic alphabet of Glozel and similar finds at Alvao in Portugal are grist to their mill.

In addition quasi-political factors have entered into the controversy—Fradin an obscure peasant, Morlet a provincial doctor without much influence, have a definite appeal for the proletariat and for a large section of the press.

And finally, it must be remembered that the Academicians are not always right—that they ridiculed Pasteur and Boucher des Perthes; and even Koch and Lister met a similar fate in the beginning.

All these elements co-operate to keep the spark of life in Glozel. Within the past few weeks the publication of an exhaustive treatise by Dr. Morlet has been announced.[3] This, however, I fear, can throw no new light upon the subject.

As a detective tale the story of Glozel remains unfinished and will remain so until a Sherlock Holmes discovers the person or persons who manufactured the articles and put them in the ground. What was his motive? How are we to explain the extraordinary industry that has fashioned 5000 or more articles, and how is it that he, the "Esprit de Glozel," escaped detection in a community of 29 souls where everyone knows everyone else's business. Or how, if there are witnesses to the dark deed, can we explain an unbroken neighborly silence extending over a period of six exciting years?

Herbert photo

"The International Commission" of scientists making an official investigation

Herbert photo

Dr. Morlet demonstrating his claims at the site, before the members of the "International Commission" of investigation. Vayson de Pradenne, president of the Prehistoric Society of France, in *Antiquity*, characterises him thus: "Still young and endowed with wild energy, with an inflexible resolution and a naïve and immoderate self-esteem; devoid on the other hand of competence and of the critical faculty, he threw himself whole heartedly into the fray"

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[2] Similarly, the enthusiastic Dr. Morlet has sent clippings, newspapers, and pamphlets, and his publisher a book by the doctor, to a member of the *Scientific American* staff who, when passing through Vichy, attempted to see him, but who was given to understand by some one within the Morlet household that the doctor was seeing no one, and who left his card. Residents of Vichy suggested that the doctor was finding it expedient to "hide out" at the time, until the legal storm might blow over. —*The Editor*

[3] "Glozel," by Dr. A. Morlet, a copiously illustrated work published by Georges Desgrandchamps, 23 rue Boissonade, Paris (XIV$^{\circ}$). The especially interested reader will find a 20-page article entitled "The Glozel Forgeries," by A Vayson de Pradenne, President of the Prehistoric Society of France, in the journal *Antiquity* (Gloucester, England), Volume 4, No. 14 Several *Cahiers de Glozel*, some by Dr. Morlet in his own defense, have been published by Paul Catin, 3 rue Sabot, Paris (VI^{c}); other matter, by Octave Belin, 26 rue Pasteur. —*The Editor*

BY-PRODUCTS FROM INDUSTRIAL WASTES

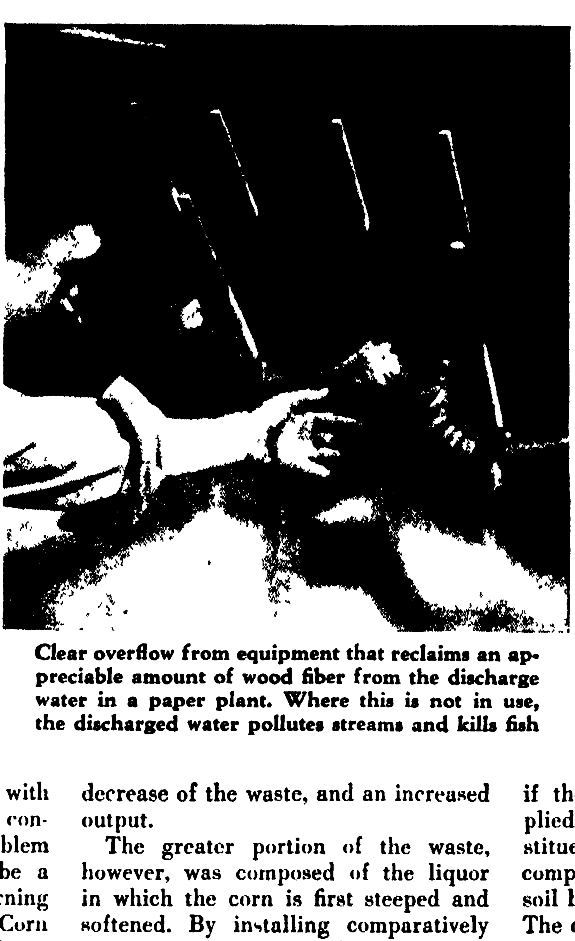
By ERNEST W. STEEL
Professor, Municipal and Sanitary Engineering, Agricultural and Mechanical College of Texas

A STATE legislator not long ago seriously advocated the abolition of the state health department, and by inference all health departments, on the ground that at best they were wasters of public funds and nuisances. Persons of the same opinion may be surprised to learn that the complaints of health officials have stimulated industries to reclaiming large amounts of valuable materials which were wasting unheeded into streams and municipal sewage.

The liquid wastes of many industries are of such a nature that they cause serious troubles in streams and at municipal sewage treatment plants. In the streams, fish are killed and the water is made unsuitable for water supplies and recreational uses. At the sewage treatment plants, the biological action may be upset by antiseptic substances, or the enormous volumes of organic matter from the industry may overload the plant to such an extent that it must be increased in capacity or must bypass untreated liquid into streams. Accordingly, many industries have in the past few years been notified by cities and state health departments that the burden of waste treatment must be assumed by the industry, either completely or in large part, before final discharge into sewers or streams is permitted.

SUCH notices have been received with apprehension by the industries concerned until study of the problem showed that what appeared to be a liability was capable of returning profits. An example of this is the Corn Products Refining Company of Argo, Illinois, which manufactures starch and other corn products. Final disposal of its liquid wastes is a matter of much concern to the Chicago Sanitary District. The chemists of the District found that the wastes of this plant were so large in volume and contained so much organic matter that they were equivalent to the sewage of a population of 800,000. The treatment of this waste was, of course, too great a burden to place upon the taxpayers. The alternative appeared to be the construction by the company of a special treatment plant, estimated to cost 2,900,000 dollars.

Investigation of the plant with respect to sources of the waste indicated that a considerable portion of valuable product was escaping into the waste pipes through poor control of certain processes. Improved mechanical equipment and weeding out of heedless operators remedied this. Result: a 10 percent decrease of the waste, and an increased output.



Clear overflow from equipment that reclaims an appreciable amount of wood fiber from the discharge water in a paper plant. Where this is not in use, the discharged water pollutes streams and kills fish

The greater portion of the waste, however, was composed of the liquor in which the corn is first steeped and softened. By installing comparatively inexpensive equipment the steep-water can now be evaporated to such a consistency that it can be used for making a stock feed. Result: an annual return of 500,000 dollars which was formerly lost through waste, and a reduction of volume and concentration of the plant waste from a population equivalent of 800,000 to about 50,000. The present wastes owe their strength to the organic matters distilled over in the vapors of the steep-water during the concentration process. It is possible that some valuable constituents can still be extracted, and further experimental work is being carried on.

Another industry which has frequently been embroiled with health departments is that of coke making. Coke is made by distilling coal, and many valuable products are in the distillate. After these are removed, there remains a liquid containing tar acids and phenol, or carbolic acid. The latter is especially troublesome, particularly if the stream or lake which receives the wastes is a source of municipal water supply within many miles of the point where the waste enters. If the water supply is chlorinated, the phenol taste is particularly bad. The disagreeable medicinal taste of the combined phenol and chlorine has been noticed when the water contained only 1/25 of an ounce of phenol to a million gallons of water. Methods of recovering phenol from the still-waters have been developed and now it is possible to extract it and obtain salable phenol in amounts sufficient to pay the cost of extraction.

THE phenol problem has also received much attention on the part of scientists of France, Denmark, and Germany to prevent pollution of the relatively small rivers of those countries. From their studies comes a new and startling solution. It has been found experimentally that if the phenol-containing liquid is applied to the soil, the injurious constituents are converted into ammoniacal compounds which can be utilized by soil bacteria and act as crop fertilizers. The conversion process takes about two weeks. Previous to the change, of course, the phenol is injurious to plant growth and accordingly the liquid must be applied a proper length of time before sowing. A very important advantage claimed is that, while the phenol is still active, it will destroy weeds and injurious insect larvae present in the soil. The combination of fertilization and weed and insect killing properties may change entirely our methods of disposing of this troublesome waste.

In the bituminous coal mining regions of the eastern states there have been many disputes between mine operators, cities, state health departments, and fish conservation commissions. The drainage water of coal mines contains little or no dissolved oxygen and hence will not support fish life. It will so lower the oxygen content of streams into which it discharges that fish cannot live in them. Mine wastes are even more troublesome because of the acid and other chemicals which they have dissolved out of the coal beds. Acid is a killer of fish and in addition makes the polluted streams black and evil smelling and unsuitable for municipal water supplies. The only remedy found so far has been to require owners of mines to seal up those abandoned workings from which drain water trickles down the hillsides. Lately, however, the Kaplan process is reported from West Virginia. It consists of adding to the mine waste a complex chemical which combines with the undesirable chemicals to form a useful blue pigment, which has a far greater value than has the chemical reagent added. Appropriately enough, the new pigment has been called Monongahela blue.

IN all of the forested states are mills engaged in turning wood into various grades of paper. The process requires much water—to break down or digest the wood into fiber, to wash it after digestion, and to convey the fiber around the plant through pipes and channels. Indiscriminate discharge of the wastes has changed streams which traverse regions of great scenic beauty into black and evil-smelling open sewers. Fish are destroyed. Regions which are ideal for camping, fishing, and vacationing are spoiled.

The paper industry, however, after exertion of much pressure by state health and game officials, is doing much to remedy the situation. Study of plants indicated that much of the conveyor water with its valuable fiber was escaping accidentally or through remediable carelessness. Some fiber unavoidably escapes from the paper machines. This waste is being reclaimed by special patented sedimentation processes which allow return to the plant of the rescued stock. At some plants the water, after removal of fiber, can be returned for further use. This is especially profitable where the water must be pumped long distances from the original supply or must be filtered or otherwise treated before it can be used.

The wastes from the digesters and washers contain much chemical matter that is especially undesirable in streams. The chemicals need not be lost, however, and most paper plants are now installing systems for evaporating this waste. After evaporation, the residue is burned and the chemical is regained in a modified form. The magnitude of this procedure is indicated by the fact that 7000 gallons of water must be evaporated for each ton of pulp manufactured.

Most troublesome of all problems to the paper industry is the disposal of the highly corrosive liquid wastes from the sulfite pulping process. Some progress has been made by some plants which are converting the waste into adhesive and other by-products having commercial value. Experimentally, investigators have found that alcohol, road binders, linoleum cements, dyes, fertilizers, and many other products can be made. The difficulty is that sulfite waste is produced in such enormous quantities that if all of it were converted into by-products, the market probably could not absorb them all, although alcohol manufacturing may possibly be the final solution.

THE textile industries also produce troublesome liquid wastes. Foremost among these in difficulty of treatment is wool-scouring waste. It contains much dirt, wool fiber, and grease. Wool fibers can be caught on fine screens and returned to the plant. Grease is highly undesirable at sewage treatment plants, and wool-scouring establishments are required, or at least encouraged, to remove all grease before discharging wastes into sewers. After removing grit and heavy dirt, the waste is treated with sulfuric acid which changes the grease into a thick scum and sludge easily removable from the liquid. The scum and sludge are then pressed and the grease is squeezed out. The grease so obtained is very largely lanolin, which is much used as a base for medicinal ointments. The cake that is left behind after grease extraction has some value as a fertilizer.

The most frequently encountered waste is that from plants which handle milk or manufacture milk products. At sewage disposal plants, milk waste sours and upsets the normal bacterial action. Discharged directly into streams, the usual results of stream pollution, nauseous odors, and killing of fish follow. The whey from cheese-making plants is especially troublesome in this respect. Whey has been found to be a valuable hog food and is returned to farms for that purpose. The ordinary milk wastes contain much casein. It can be precipitated by small amounts of sulfuric acid and the resulting thick sludge fed to chickens or hogs. Since casein has many uses in the industries and can be converted into glue, or into poker chips and other artificial ivory objects, it is highly probable that the large condensed milk and cheese factories will eventually salvage this material.

IN spite of the progress which has already been made, stream pollution by industries is a rapidly growing problem. This is due not only to the increasing industrialization of the country but also to the tendency of industry toward decentralization. Formerly industries grouped in certain regions or in the large cities. Their wastes, together with the domestic sewage of the large concentrated population, were discharged into the large rivers, lakes, or harbors where centers of population naturally developed. Comparatively few bodies of water, therefore, were grossly polluted. Now, however, factories of all kinds are scattered over the country. Advantageous as this may be to the industry and to its employees it has been harmful to many streams.

Possible damages to streams should be a matter of concern to all industries contemplating relocation. Town and city officials who are tempted to bid eagerly for a new industry would do well to inquire into the nature of the wastes which it may unloose upon the countryside. Should deleterious wastes be features of the particular manufacturing process, an agreement as to their disposal may prevent unpleasantness. Finally, where wastes are already causing trouble, scientific inquiry, carried on by the industry in co-operation with the proper governmental authorities will probably bring about a solution to this problem, the growth of which is measured by the growth of industry.

Milk wastes discharged into streams cause harmful pollution. This photograph shows creamery wastes being used to irrigate a farm

THE YOUNG GIANT: NATURAL GAS FUEL*

THERE was a slight trembling as, 480 feet below the surface, the crude string of tools dropped into a pocket. The trembling became a dull rumbling, like distant thunder, and the rumbling a rapidly swelling roar until there burst from the mouth of the rough casing a mighty column of mud, oil, and water, borne on the driving fist of a tremendous pressure that rocketed tools and equipment high into the air.

The drillers cheered. At last, after two years of slow, plodding effort, they had struck oil. They were rich.

But their cheering was short-lived. The dark stream soon thinned out and then disappeared altogether, leaving only a colorless substance escaping into the air and a roaring noise that seemed to mock them. The well was a failure, it seemed, for they had struck, not oil, but a gas pocket.

For days the terrific pressure blasted millions of cubic feet of natural gas into the atmosphere in an ignorant waste that would make the gas producer of today weep, while the owners of the well stood around disconsolately and wondered if any oil would follow. Finally, after weeks of waiting, they gave up hope. Some months afterward the roaring gas jet was ignited and the towering torch lighted the countryside for miles around, symbol of a later day when natural gas would be burned for heat and power in home and industry.

THE above incident, which is typical of hundreds, probably, in the early boom days of the petroleum industry when oil was the gold men sought, actually took place at West Bloomfield, New York, in 1865.

As a matter of fact, natural gas is as old as petroleum in the experience of men. But because it was often practically invisible, ignorance shrouded this masquerading giant of power in a veil of superstition for many centuries. The ancient oracle of Delphi is said to have been situated near natural gas fissures. According to the story, a shepherd noticed that some of his goats wandered about queerly in a certain spot. Going over to investigate, he felt a certain lightness coming over him. Villagers came at his call and immediately experienced the same dizziness, talking in disjointed sentences. So they concluded that a god must live there who had cast a supernatural spell on the place, and accordingly built a temple on the spot.

The Chinese and Japanese may have been superstitious too, but apparently they didn't let their fears blind them to the useful nature of the product. Plenty of evidence has been found to show that these people burned natural gas and even transported it in crude lines made of bamboo or animal intestines. History is full of similar instances. But it was not until 1821 that the first gas well was sunk near a spring at Fredonia, New York—a good 38 years before Colonel Drake's historical oil well at Titusville. Like petroleum, however, gas had been discovered before while boring for salt.

Between superstition, ignorance, and, later, mechanical difficulties of production and transportation, it has taken man many centuries to tame the "wild spirit" of prehistoric times and put it to work for him. A natural gas pipeline map of the United States would show a connecting maze of gas lines in many parts of the country, yet not so very many years ago natural gas was only a by-product, a waste that had to be blown off sometimes before the oil came; or, at best, something that held the pressure which carried petroleum to the surface and saved a certain amount of pumping.

Natural gas operations represent literally an "industry within an industry." Yet the business of producing, transporting, storing, and marketing this

Ewing Galloway

A scene typical of many during the early days of oil well drilling: a well comes in with a roar of gas which, accidentally becoming ignited, is wasted

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*Reprinted through the courtesy of *The Lamp*.

product differs widely from that of petroleum in many respects.

Consider production. In appearance, a gas field looks very much like an oil field to the layman. There are much the same derricks, tools, toolsheds, and pipe-lines. But the problem of pressure is much more vital in gas operations. The producer cannot put his well on the pump, as the oil man can, when the pressure fails. And the first well down in a new field, naturally enough, gets the full pent-up pressure of the entire area, which may be considerably reduced by the time other bits reach the gas-bearing sand. On the other hand, pressure is not always an indication of how prolific a field is likely to prove. Many an apparently promising area has come suddenly into being, yielded abundant stores for a year or more and then just as suddenly gone dead.

Just as difficult is the problem of transportation. Where the oil man can ship his product by pipe-line, tanker, tank car, by barge, in barrels, or in any other way that emergency may suggest, the gas producer has only one channel of transportation—pipe-lines.

ONE of the most perplexing problems, however, which the industry has had to face—one which has largely been solved by developments entirely without its sphere—has been that of marketing. As might be expected, the first use of natural gas was in the home. In areas within reasonable distance of producing fields, natural gas could be supplied cheaper, very often, than the manufactured product. But here the industry was up against the problem of seasonal demand. Inevitably, extremely cold days multiplied the drain on his pipe-line system eight to ten times. Just as surely, morning and evening drew heavily on the lines, with consumption comparatively slack during the day. Natural gas can not be manufactured as needed. If the supply is too great, the product must be kept in the ground. If it runs short, the producer has to find new fields if he expects to stay in business.

Let's see what the industry has done to get around these obstacles.

First of all, there is far less waste than in the old days. Seldom does one see gas blown wantonly into the air from wells sunk into strata containing both gas and oil. The former is far too useful for re-pressuring oil sands—to say nothing of its commercial value—to throw away. Next is the matter of storage. The producer today has found that by far the most efficient and economical method of storing his product is right in the ground from which it came.

It has been the widespread growth of industry and manufacturing, however, which in the last analysis has changed the whole outlook of natural gas markets, given the producer an incentive for seeking new and richer fields, and economically justified the huge capital expenditures for lines from producing areas to industrial centers.

A rugged ten miles of scenery on the Denver gas line. In distributing gas from the fields, pipe-lines must be laid across mountains and through rivers

The United States is the greatest manufacturing nation in the world. Nor are the factories and industrial plants of the country now crowded into the northern states, as they were in former years. Today industry thrives in the south and west where formerly cotton pickers crooned in the sun and cattle roamed the plains. The natural gas business was quick to realize that here was a chance for mutual development. Its new customer would consume gas in large quantities, and at a comparatively uniform rate throughout the year. In return, the industry could offer him the cleanest fuel known to science with a high heating value of approximately 1000 B.t.u. per cubic foot, one that burns completely with no smoke or ash.

It has been estimated that there are over four billion dollars invested in the United States today, in the various producing and marketing areas scattered over the map, with thousands of miles of trunk and feeder lines, like spider webs in a garret. The output of energy from natural gas burned in the United States during 1929 was estimated to be equivalent to 527 billion kilowatt hours—nearly six times the total production of electricity for the same period. Known fields, with improved methods of computing reserves, give the industry almost unlimited supplies of raw material to work with. Texas Panhandle and the Monroe-Richland field alone can assure the industrial markets of the south and middle west of adequate resources for many years to come. Yet all these assets of supply, scientific methods, and expanding markets which Nature, their own inventiveness, and evolving conditions have given the men engaged in natural gas operations, might well prove to be so many stones, yielding no profit, were it not for one thing. The industry has found to a remarkable extent the way to real practical co-operation.

The natural gas business is not a one-man job, so to speak. The product itself is easily susceptible of waste; and producing areas, unless scientifically drawn upon, may lose much gas that never reaches the market. The laying of lines from field to market involves the expenditure of millions of dollars. In distributing the product to numerous towns along the right of way, as well as at the destination of the main line, countless local interests have to be taken into consideration.

Here, then, is an invaluable natural resource. To bring it from its age-old prison, thousands of feet under the earth, to the burners of various industries in widely separated parts of the country, calls into play hundreds of varying interests. Producer, landowner, engineer, municipality, consumer, scores of others, all have their rights; all must be considered. The tiniest cog can wreck the whole machine.

SO the tremendous projects which have been successfully swung by the natural gas industry speak volumes for the fine degree of co-operation, orderly exploitation, and scientific development within its ranks.

The eastern section of the United States was the cradle of the natural gas industry in America. From the producing fields in West Virginia, Pennsylvania, and east Ohio has crept a maze of pipe-lines carrying fuel to the scores of industrial centers throughout that territory, until the map takes on the appearance of a jig-saw puzzle. Today those eastern subsidiaries of the Standard Oil Company (N. J.) operate something like 16,000 miles of main and feeder lines, with estimated distribution for 1930 of 104 billion cubic feet of gas.

Yet, even before eastern markets for natural gas had developed to their present proportions, the wildest gambler would never have undertaken to pipe the product to Baton Rouge, St. Louis, or any of the great centers of the south or middle west. The industry would have laughed at him. And—at that stage of development—it would have been right. Production methods were not as scientific as they are today. Nor were the compressors and lines of a quarter century and more ago as efficient as they are today. Men had no way of estimating with any degree of accuracy the potential output of a field, and the industry could hardly be expected to gamble an investment which it would have to carry 10 or 20 years on the chance that the elusive material in the sands under their wells would last that long. Finally, many of the markets in the south and middle west were not yet ready for natural gas.

So fate played a fortunate trick on the industry in hiding from geologists the prolific Monroe-Richland and Panhandle fields until a time when the engineer and consumer had prepared the scene for more extended use of their treasures.

Panhandle is undoubtedly the greatest natural gas producing field in the world today, with the Monroe-Richland area not far behind. It is almost impossible to estimate how much gas lies locked in the sands of these two fields, needing now only the turn of a valve to release it. But a fair idea may be gained from the fact that the combined capacity of lines already tapping them runs up to several hundred million cubic feet daily.

Amarillo field alone, in the Panhandle district, was thought two years ago to hold some 10¼ trillion cubic feet—enough to keep a line of 100,000,000 cubic feet per day capacity operating continuously at full force for nearly 300 years. That this great natural wealth may be expected to last many years is plainly testified by the investments of many millions which have gone into the construction of 300-, 400-, and 500-mile lines.

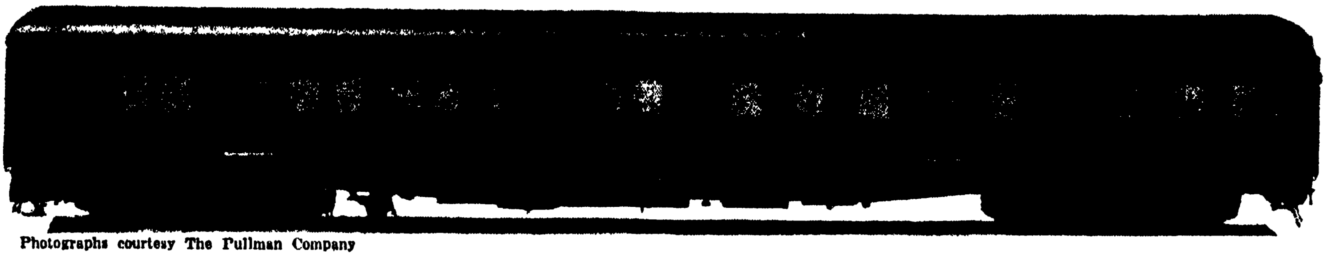
There are three main projects through the south and southwest in which Standard Oil Company (N. J.) subsidiaries have an interest, the most recent being the Mississippi River Fuel Corporation's 431-mile line from Monroe to St. Louis. In addition to the main line, branches will make the gas available to industrial plants in Crystal City, Missouri; and in East St. Louis, Granite City, and Alton, Illinois. Other industrial consumers within reach of the main line through Louisiana, Arkansas, and Missouri also will be served.

In 1927, the Interstate Natural Gas Company completed its line from Monroe to Baton Rouge. The Interstate also contracts to furnish gas from its Monroe reserves for the Southern Natural Gas Corporation's line to Birmingham, Alabama; Atlanta, Georgia; and various adjacent points, as well as to several other interests. Over in Texas the Canadian River Gas Company transports the fuel from Amarillo Field, in the Texas Panhandle district, to Clayton, New Mexico. Here it is purchased by the Colorado Interstate Gas Company (N. J.), and brought to Pueblo and Denver, Colorado, as well as to other towns along the way. In addition, the Colorado Interstate supplies gas for a line north from Denver to Fort Collins.

And so the natural gas industry has grown. Once a "wild spirit," represented by mysterious pillars of fire that issued from fissures in the earth to terrorize natives, then an incidental by-product of oil drilling, natural gas today not only has found its way into homes in many districts, but more and more is replacing its brothers, fuel oil and coal, for numerous industrial purposes. Glass, ceramic and cement plants, steel mills, brick, lead, enamel ware and vitrified clay manufacturers, oil refineries, power plants, and all other industrial users within reach of existing or projected lines are giving ample illustration of the value of the product.

To what extent new producing areas, further improvements in drilling and transporting techniques, and the possibility of mixing natural with manufactured gas for maximum economic usefulness in larger centers may justify extending the web of pipe-lines to other parts of the country, plans already announced and others in formation will reveal in the next few years.

Back to the primitive. In swampy land such as this, oxen and mules have proved to be about the best motive power for transporting pipes for the pipe lines



Photographs courtesy The Pullman Company

Invalids to or from the Mayo Clinic at Rochester, Minnesota, may ride in comfort in this special car

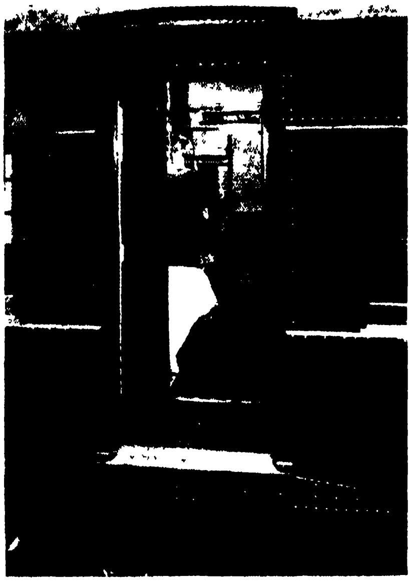
THE SICK MAY RIDE IN PULLMANS

THERE have recently been built, for operation on the Chicago and Northwestern Railway, two Pullman cars specially designed for the comfortable transportation of invalids. These cars will be operated between Chicago and Rochester, Minnesota, home of the famous Mayo Clinic.

Besides the regular platform entrances at the car ends, three doors are placed on one side of each car for the direct entrance of stretchers. These special doorways are 30 inches wide and two of them are so located that a patient on a stretcher may be carried directly into the room he is to occupy; the third provides access to the open-section division of the car. The rooms thus reached are extra wide, and provided with extra wide doors, so that the transfer from stretcher to bed can be made with the least discomfort to the patient.

Each car contains eight open sections, one drawing room, and four rooms; each room having a stationary single bed and an upper berth, as well as folding lavatory arrangements. The upper berth is available for occupancy by an attendant. At the section end of the cars is the lavatory for men, while that for women is at the opposite end.

Particular attention has been given in the construction to eliminating as much as possible the noise of travel.



The side door, 30 inches wide, gives access to one of the private rooms

Diaphragms at the car ends are spring-hung from the top, the arrangement greatly reducing the amount of car-end rattle. Further, rubber insets have been placed between car trucks and bodies at points of contact, to absorb shock and further reduce noise. The cars are also equipped with roller bearings.

Of invalids who require to travel, the proportion who are entirely bed-ridden is small; nevertheless a considerable number are either bed-ridden or require support in getting about; for these latter a short stretcher, really a canvas seat, 30 inches long, has been devised. This stretcher can be easily handled on entering or leaving the car, because the corridors have been widened for the special purpose of accommodating them. In the ordinary car it has often been necessary to remove a window sash in order to permit a person on a stretcher to be lifted in or out.

The third side-wall door, for patients whose space is in an open section, opens into the crosswise corridor which separates the men's lavatory from the aisle between the sections. Thus only one turn has to be made in carrying the patient in or out, and the use of the platform door and vestibule is avoided.

In a number of other details these cars have been arranged to accommodate this special service; for example, electric heating pads are provided. The cars were designed under the supervision of Dr. Thos. R. Crowder, Director of the Department of Sanitation and Surgery of the Pullman Company. They are appropriately named the *Ephraim McDowell* and the *Joseph Lister*, in honor of two men whose contributions to surgical science have been particularly notable. Ephraim McDowell was not only a country doctor, but a country doctor of pioneering days; he practiced in and about Danville, Kentucky, and there, in 1809, successfully performed the first major abdominal operation ever undertaken, for the removal of an ovarian tumor. There in the backwoods, before the days of anesthesia, unassisted, and with only the crudest of facilities, his boldness and skill combined to bring success in an operation of a type which, now commonplace, has since been the means of saving uncounted lives. Dr. Joseph Lister was the English surgeon who discovered and developed the principles of antisepsis.

The loading and unloading of invalid passengers bound for the Mayo Hospital is rendered easy by the side doors which permit the direct transfer of the patient on a stretcher to the car

A typical scene taken during the filming of a talking motion picture. The microphone is the cylindrical object suspended by cords in the center of the set

THE TECHNICIAN TALKS ABOUT THE TALKIES

By RAYMOND FRANCIS YATES

SINCE the silence of the silent drama has been so effectively—or shall we say devastatingly?—broken, much has been said pro and con concerning this new magic of the movies. It must be confessed that, as measured by the box office receipts, "talkies" have, within the startling space of two years, emerged from the state of an uncertain experiment into that of a bombastic success. How deserved this success has been from a purely artistic or esthetic viewpoint, or how lasting it will be is a matter of some conjecture even at this late stage of development. This much may be said, however. The movie makers have, by sheer luck, struck upon a ready-made, ready-to-use idea that has revitalized the whole industry and captivated a public that is still applauding with enthusiasm.

As large as the success of this new idea has been there are many dissenting votes and much disillusionment on the part of movie goers who want their drama on the hoof, and who demand something more dramatically and emotionally substantial than heated bedroom scenes and voices that sound as though they might be produced when noses are clamped with clothes pins. In short, the talkies have not been universally successful and the possibilities of reaching this point will become more and more remote unless our movie manufacturers see more quickly their folly in attempting to produce pictures to meet the fickle demand rather than a standard of artistic perfection. We have seen and heard the talkies in their unpolished nakedness, and now we want stark realism with a ring of real sincerity back of it.

THE movie manufacturers have still much to learn of technical control of sound recording. To put a bald record of voice or music on the sound track of a film or the wax of a record is one thing. To give that record the expansive breath and verve of life is quite another thing. Even a superficial observer of talkie technique cannot help but lament the obvious absence of realism that is so noticeable in the average production. Contrary to what appears to be the established opinion of the critics, the fault does not lie wholly in the technical limitations of the electrical equipment but partly in its manipulation. To draw an analogy: the movie makers are playing a Stradivarius with the technique of a fiddler at a barn dance. In their frantic effort to please a fickle public and to take advantage of a demand that has swept down upon them with unprecedented fury, they have failed to tap the resources of their equipment.

Situated between the microphone in the set and the recording apparatus there is what is known as a mixing panel. Here the monitor listens-in on all sounds passing over the circuit on their way to the wax and photographic film records. This vigil of the monitor is of vast importance for it is he who regulates the degree and intensity of the sound-laden currents passing over the circuit on their way to the "canning factory." The monitor is lord over all that he hears; he may by a twist of his wrist make a whisper out of a call for help, or he may on the other hand make a cough sound like an eruption of Mt. Vesuvius. It is all in the knobs!

At present it is the monitor who is the weak link in the chain. He is all technician when he should be part technician and part artist. He is interested largely in microamperes and the response curves of audio-frequency transformers when esthetic effects and realism should be uppermost in his mind.

SOME months ago the writer was seated in the studio theater of one of our largest producers, reviewing bits of a musical comedy that had recently been filmed. The novices present talked with a learned air about the "highs" and "lows" of the recording, at the same time being serenely insensible to the appallingly bad job of monitoring that had been done in recording the sound. There was a close-up of a young lady engaged in a normal conversation with a friend. While talking, this young lady turned her back to the audience, but there was no change whatsoever in the intensity of her voice. Here the simple turn of a knob might have added a valuable touch of realism for it is obvious that orientation has a pronounced effect upon the voice. During conversation, turning the head affects the volume of the sound reaching the ear of the listener. A small effect, to be sure, but not small enough to lose every vestige of importance. It is going to be through the painstaking attention to these small effects that the movies will eventually emerge into a state of polished and formal art. The paramount question is,

THE motion picture, and now the motion picture in its talkie form, has become such an integral part of the average person's daily life, that any suggestions for improvement take on a personal interest. In the accompanying article Mr. Yates points out some of the failings of the talkies, and how they may be overcome. His technical background in sound work gives the voice of authority to his statements.—*The Editor.*

"When will the talkies learn to talk?" The answer lies with the technicians whose esthetic sense is usually no keener or more susceptible than that of a coal-wagon driver or an ice-man. It is a far cry from the grid bias of a vacuum tube to the artistic niceties that will eventually put more interest in faithful reproduction.

Some of the efforts of our movie makers to produce realistic effects are painfully amusing to one who has any knowledge of the technical considerations involved. There is a scene on the screen showing a canoe being paddled down a stream in an enormous canyon. The canoe is almost an insignificant speck, a dot in the void of a great spectacle of nature. Strange as it may seem, one hears the dip of the paddle. One who knows the making of the talkies can visualize a stage-hand standing beside a tank of water placed under the microphone and dipping a paddle so that the great American movie audience will be treated to a bit of realism. The whole scene was incongruous enough to make a school boy laugh.

Realism in talkies will not come as an over-night development. It is something that must be fathered, something that must be nursed, something that must grow out of a multitude of unpardonable mistakes. It is something that must be first felt and then learned. However, when one considers that we have had nearly three years of unrestrained talkie making, one is inclined to believe that the perfection of realism has not been as rapid as it should have been. Let us take another example of bad talkie making.

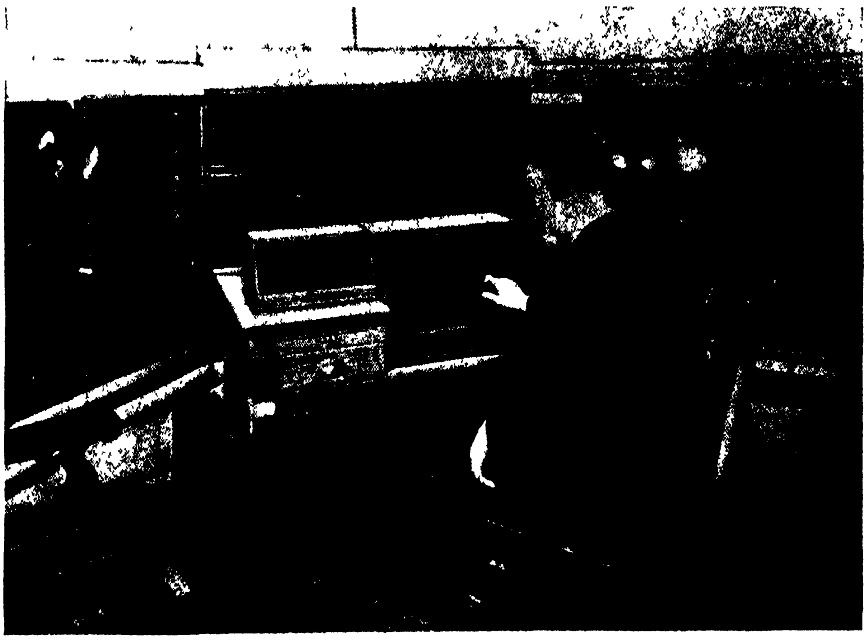
THE scene is a living-room. There is a normal conversation taking place between the occupants. The recording is, on the whole, fairly good. There is a quick flash to the platform of a railroad station. A locomotive with a string of Pullmans rushes into the scene and stops. The effect is terrible. What has happened? The sound produced by the approaching locomotive, a locomotive that one would think almost knocked the tripod from under the camera so closely did it approach, had a volume that was not much greater by comparison than the voices that immediately preceded it in the living-room set. The effect was strikingly incongruous. There was no dramatization at all. The locomotive should have thundered into the scene with a rattle of monstrous iron wheels, with the screaming of brakes and with the glamour and noise that always attends the approach of such gigantic pieces of mechanism. This particular locomotive really almost whispered its way into the scene.

It might be confessed here that the technical equipment in present use is not designed to handle the recording of an approaching locomotive the way the recording of an approaching "he" locomotive should be handled. There is some question as to whether or not this terrific high level of sound intensity could be passed through the amplifying tubes. The question arises: "Why would it not be possible to arrange an automatic switching in of additional amplifying equipment and additional horns so that the whole theater would resound with the thunder of the great iron horse?" It is true that sound amplification, when the sound takes the form of noise, can be amplified to a tremendous extent without the audience becoming at all aware of any distortion. When the sound of an orchestra is recorded the engineer must take care to keep the mould of distortion cut away but when he is recording noise such as the eruption of Mt. Vesuvius or a battle scene, the "sky is the limit." Perhaps we may look forward to the day when locomotives will be locomotives and battle scenes will sound more realistic than Boy Scout Troop No. 125 having their annual outing.

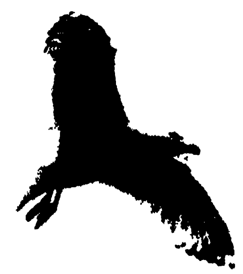
At the present time it is the general practice to place the ear of the "talkies," the microphone, in the center of the set. The technical reasons for this practice have never been made quite clear to the writer. Would it be unreasonable to assume that the microphone, representing as it does the ear of the audience, should be placed at the front of the set in a position bearing the same relation to the performers that the audience bears to the screen? With the microphone assuming this position it would appear that a portion of intelligent monitoring might, to a certain extent at least, be automatically solved.

A still more glowing example of bad manipulation of equipment was recently made obvious when a performer entering an extremely deep set from the back, walked into a close-up as he talked. The monitor had made no effort to fade him in. The sound effects were distinctly displeasing and somewhat incongruous when one realized that a sixty thousand dollar oriental rug adorned the floor and the room was furnished with a carload of expensive trappings fit for kings. There is no expense to which a well-managed studio will not go when it comes to supplying the necessary furniture and equipment and scenery for a major production. It makes one wonder why the smaller details of sound recording are permitted to pass by practically unnoticed.

IT would seem that sound recording is now in the same state of perfection that photography was in 15 years ago. This sorry state of affairs has been brought about by giving the technicians, the sound engineers if you will, too much of a free hand at the studios. Their judgment is in no case tempered with artistic sensitiveness; they cannot see the woods for the technical trees. They are interested in curves and technical precision and they have quite forgotten that technical precision is a far cry from artistic realism. It matters not to the man in the audience whether a tube is biased correctly or whether a resistance deviates one watt or 50 watts, he has come to the theatre to see life lived on the screen, to see an illusion that will be so perfect as to cause him to forget about his daily troubles, his trials and vicissitudes, and the sooner the talkies can deliver this message to him in the true, unvarnished voice of life, the sooner the talkies will be here to stay.



The monitor operator sees all and hears all. He should be part technician and part artist, for by a twist of the wrist he can improve or mar a sound record



A herring gull in full flight showing the slots of its wings opened

A sailing kingbird flying slowly. Primary feathers are outstretched but the false wings forming slots are barely visible

Courtesy *Nature Magazine*

BIRDS HAVE NATURAL SLOTTED WINGS

By RAY P. HOLLAND, Jr.

SLOTTED wings seem to be one of the most recent of the greater aerodynamic developments. It has been in comparatively recent years only that they have been used to any extent at all. As they are used on the airplane, they seem to be one of the man-made devices which have no parallel in nature. There are many such things that appear to have been developed entirely in a scientific laboratory or as the result of continual development of complicated theories. When the result is finally reached and the product is finished, the general opinion is that something entirely new has been made. Then, suddenly, it becomes known that the identical thing that man has worked so hard to attain has existed all the time in a rather simple and surprisingly perfect application in nature.

Slotted wings are an excellent example of this. In nature they are almost as old as flight itself. The earliest flying creatures had no feathers. They flew with a skin web as the supporting surface, as does the bat. With the development of feathers, the primitive slotted wing appeared. That which corresponds to the fingers of our hand became the long, stiff feathers that form the wing-tip of the bird. The thumb developed, on the bat, into a projection to aid it in clinging to walls. On the bird, it became what has been known as the "false wing" or "bastard wing."

The false wing consists of a small group of long, stiff feathers above the leading edge slightly less than half the distance to the wing-tip on most birds. In its normal position, it fits into the conformation of the wing so well that it is not easily seen. When open, it is plainly visible. Being directly in front of the more flexible portion of the wing, it is in a perfect position to direct the airflow over the lateral control surfaces. Thus, in its function it is like the airplane slot.

The manner of operation is slightly different. Naturally, because of mechanical reasons, the bird can not open its slot directly to the front as on the airplane. The means it uses is to move the tips of the slot feathers forward and downward with the joint where the group connects with the wing proper as the pivot. The portion of the wing left exposed by this motion is very well shaped to produce high lift. The feathers of the false wing are disposed so that the cross-sectional shape of the airfoil they form is easily altered. When the slot closes again, the feathers shape perfectly into the wing. It is the ability to change shapes and areas at will that gives the bird such a remarkable control of its flight.

The primary feathers that form the wing-tip of a bird have an aerodynamic action somewhat similar to that performed by the bastard wing. The quill of these feathers is close to the front edge. Each feather is an airfoil in itself. They are arranged so that in overlapping, the leading edge of one feather is above the trailing edge of the feather in front of it. The nearer the end of the wing they extend, the more they diverge, until before the tip is reached, there is space between the individual feathers. The effect is that near the wing-tip there are several airfoils at high angles of attack, one behind the other, the whole group forming one large airfoil. Although not exactly like a multi-slot wing, this arrangement probably has some similar characteristics.

IT is likely that the tips of the primary feathers, which are free to twist over certain limits, place themselves in positions with negative angles of attack when the bird is in certain attitudes. This would form a true multi-slot wing. Mechanical difficulties prevent man from using such a wing, although he understands its action perfectly. This type of wing using numerous slots has been tested in a wind tunnel up to over 40 degrees angle of attack without reaching its "burble" point. The bird probably makes use of the principle in landing and in slow flying. At that time, the tip feathers are spread wide. In rapid climbing, maximum lift is obtained in the same manner.

When high-speed level flight or a dive is desired, the bird's wing-tip moves to the rear in relation to the rest of the wing; folding closes the openings between feathers. In addition to closing the slots, this action furnishes a desirable sweepback. Moving a supporting surface to the rear will move the center of pressure in the same direction and steepen the dive. In extremely rapid dives, birds fold their wings until they are scarcely stubs on the sides of the body. In this means of airfoil modification, natural flight has one of its greatest advantages over artificial flight.

The very shape of the wing-tip feathers is strong evidence that they act as individual airfoils. They are flat and of practically uniform chord out to the point where they are spread wide enough to cause a space between them when the wing is spread. At that point there is a sudden tapering of the plan form. The part of the feather in front of the quill narrows down almost to nothing. The feather becomes an efficient airfoil instead of only a component in an arrangement that makes up one large surface. The cross-sectional shape of these feathers is usually similar to that used on our racing planes, but even thinner. It is so thin, in fact, that it would not be practicable to construct an airplane wing using the same proportions.

As an example of a bird which uses its slotted wings to great advantage, let us consider the wild duck. Certain species of them migrate from as far north as Alaska in the summer and southward to the Gulf of Mexico in the winter. When not disturbed, they prefer not to fly, unless they have a certain destination. In their flight to that destination, they travel in a straight line at a high speed. When disturbed, they must be able to climb almost vertically for their protection. Also, they possess a marked ability to change direction and speed suddenly when they see something that arouses their suspicion.

Suppose that an order should be received in an aircraft factory for a ship of very high wing-loading, the nearest thing possible to a racing plane, that would have a low landing speed, an ability to stunt, extremely good climb, and also be capable of long-range non-stop flights. It would be absurd to try to fill all the specifications in a single ship. Any one of the requirements could be fulfilled in a specialized job for that purpose, but no individual plane could possess all the qualities necessary. Nevertheless, a duck can do all those things.

After flying all night at a high altitude, the duck reduces its wing area to almost nothing, shifts its center of pressure to the rear, and begins a long bullet-like dive to just above the surface of the water. At that point, it increases its wing area and resistance at the same time. As its speed diminishes, the false wing moves forward from its position to form the slot. It maintains perfect lateral control up to the point when it becomes practically motionless in the air only a few inches over the water. Then, with a few flaps of the wings, it lets itself down easily. If it is disturbed, it springs from the water with amazing alacrity. A rapid and steep climb is maintained until the bird is out of danger. During this climb, the slots are continually open. They are, more than any other one thing, responsible for this performance. They increase the lift and prevent "burbling" in the attitude necessary for the climb.

DIFFERENT birds, depending on the degree to which they use them, have slotted wings developed to different degrees. Generally, the false wing is comparatively small on gliding birds. They are slow fliers that employ extremely efficient airfoils. Birds such as the albatross derive their efficiency from a supporting surface of very high aspect ratio. Their light wing-loading provides a sufficiently slow landing speed for them. Great climbing speed is unnecessary because they fly over level stretches of water with only slight changes in elevation. Their continuous gliding is made possible by the rising currents of air caused by the swells of the sea. Birds utilize these slopes of water in exactly the same manner that a sailplane uses a long gradual hillside.

Those birds which have a high-speed flapping flight have the slots developed to the greatest extent. They are birds of very high wing-loading. High-speed wing action is necessary in order to maintain flight. Nevertheless, a remarkable rate of climb and a reasonably slow landing speed can be produced. Quail, grouse, and pheasants are birds of this type. Examination shows that these birds have abnormally large bastard wings.

I have noticed that the position of the slot varies on birds of different sizes. To illustrate this, I will compare the Hutchin's goose, which weighs about eight pounds, to a representative small bird. The center of the group of feathers, on the goose, that constitutes the bastard wing, is approximately 58 percent of the distance from the body to the tip of the wing. On the smaller bird, it is only 37 percent of the distance out. The smaller bird's false wing occupies slightly over 20 percent of the leading edge, while that on the goose occupies only 17 percent of its leading edge.

HOWEVER, this latter comparison creates the wrong impression because the goose is a bird of high aspect ratio while the other is not. The slotted wing area of the goose is much larger in comparison to the entire wing area than is the case on the other bird Its wing-loading is considerably greater also. The manner of flight, in the same way that it affects the size, is likely to have a direct bearing on the position of the false wing.

On the ruffed grouse, a bird of heavy wing-loading that flies with an extremely rapid wing action, the slot feathers are very close to 50 percent of the distance to the tip On birds of light wing-loading it is usually less than half way out. These observations indicate that the bastard wing, viewed from a standpoint of size and position only, has a direct relation to the size and flying characteristics of the bird, and must be a part of its control system, and not merely a useless appendage.

If you would like to see a practical example of the actual means the bird uses to open his slotted wings, it is only necessary to obtain a bird's wing to experiment with. This should be easy, for there are many species of detrimental birds, such as the hawk or crow, that may be killed at any season. The wing of the bird, cut from the body, is all that is needed. There is a tendon just in front of the wing bone. As this is pulled the wing starts to unfold. Everything goes on normally with the false wing in its original position until the maximum wing area is reached. In landing, the bird would employ this position of its wing in order to have the lightest wing-loading, and consequently the slowest landing speed. It is also in landing that it makes the greatest use of the slotted wing. It is, therefore, logical that the action of the false wing should be governed by the tendon that holds the wing outstretched.

By pulling with slightly more force on the same tendon, the false wing will move forward and downward into its correct position to act as a slotted wing. When actually seen operating in this manner the function of the so-called bastard wing is very evident.

ACTUAL photographs showing the slots open on flying birds form the only more convincing evidence I know of. It is difficult actually to watch birds and see the system in operation, even with binoculars. The opening is slight and there is only a short period of time during which to observe it. It may be seen after much effort but not distinctly enough to be a proof. However, to take a wing in your hand and actually make the slot open, will make even the most stubborn doubter stand convinced.

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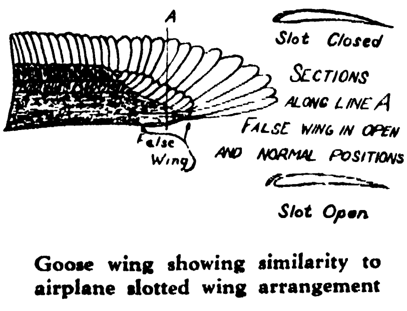
Instruction in "blind" flying is becoming increasingly important to the aerial transport industry. An article telling how it is carried out is scheduled for early release.



Goose wing showing similarity to airplane slotted wing arrangement

Left: **Comparatively small false wing on slow-flying, soaring bird**

Right: **The sudden tapering at the point where the primary feathers begin to act as individual airfoils**

THE SCIENTIFIC AMERICAN DIGEST

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TEN dollars a million for insects! Who'll buy? The average stung, bitten, and be-itched picnicker or camper may ask wearily why anybody should want to buy a million insects at that price when you get more than a million for nothing every time you show your nose out of doors.

Recently developed safe, fireless lamp for flashlight photography

But the insects that are worth 10 dollars a million are cheap at the price, for they prey on the eggs of other insects, thereby preventing the pests from ever seeing the light. They are the almost microscopic wasps known as *Trichogramma*, which are reared in captivity by Stanley E. Flanders, entomologist of the Citrus Experiment Station at Riverside, California. Mr. Flanders has been at this work for some time now, and has improved his rearing methods to a point where the tiny parasites can be produced at a thousand for a cent. They are shipped out in great numbers to orchardists, who release them to assist in their endless warfare on fruit-spoiling insect pests.—*Science Service.*

NEW PHOTO FLASH LAMP

A FIRELESS, smokeless, odorless, and noiseless photographic flash lamp has been developed by the incandescent lamp department of the General Electric Company, Cleveland. The flash is confined entirely within a bulb, with resulting advantages that are expected to revolutionize flashlight photography. Requiring only one-hundredth of a second to act, and being without hazard, it will make possible the taking of flashlight photographs in places heretofore practically impossible to "shoot," such as in trains, airships, and theaters, under water, and by insurance companies requiring night photographs under all weather conditions.

The lamp consists of a clear bulb of standard design, with the flashlight filament coated with a special preparation, and with a quantity of very thin aluminum foil in crumpled sheet form within the bulb. The bulb is oxygen-filled.

When the circuit is closed the filament is lighted and this, in turn, lights the foil. The lamp operates on any 115-volt house supply, or with dry, storage, or flashlight batteries. A new lamp is needed for each flash. The lamp is most efficient when used with suitable reflector equipment.

NEW PROCESS FOR CARBON BLACK MANUFACTURE YIELDS HYDROGEN

THE production of carbon black from natural gas has been, heretofore, a wasteful process, but experiments carried out by the United States Bureau of Mines give promise of an increased yield of more than 400 percent.

The old method, and the one in widest use, consisted of burning natural gases incompletely and collecting the unburned carbon on cold metal surfaces when the gases passed off. Sometimes the carbon black was collected by filtering the gases through cloth.

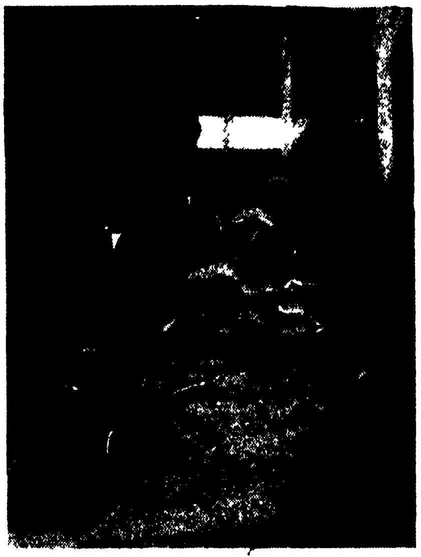
The new method calls for the passing of the gases through ignited coke. The coke is fanned to great heat by subjecting it to a forced air draft, after which the natural gas is passed through it and cracked.

An advantage to be gained by the new process is that, in addition to the carbon black, hydrogen may be recovered and used in some localities for the synthesis of motor fuel and the manufacture of ammonia and other products.—*A. E. B.*

DOUBLE-SPIRAL CONVEYOR

A NEW portable, flexible, power-driven, elevating and tiering conveyor has just been introduced and has already found many useful applications in a wide range of industries.

The TwinVeyor, as this new apparatus is called, uses a new principle: two external spiral tubes are turned toward each other by a power head. Anything placed on the conveyor travels forward rapidly, perfectly balanced. It is used for handling raw materials and finished products in bags, bales, and bundles. The equipment finds other applications handling crates and boxes, and experiments are being made handling the finished product itself, without packaging, where its shape and size permit the spirals to get hold of it. It carries bagged sugar up a 30 percent grade at the rate of 90 feet per minute, handling 1000 bags per hour.



Double spiral conveyor for bags and bales. It is motor operated

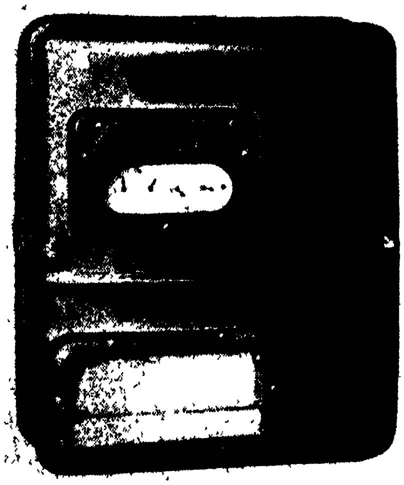
A standard unit consists of six eight-foot dual sections and a power head which draws current from any power line. Each section joins to the assembly with an automatic lock. It is easily shifted about by one man and the entire 50-foot line can be assembled or disassembled in six minutes. Flexibility is secured by the ability of any joint to take a 15 degree angle horizontally, 15 degrees up or 10 degrees down.

A hurdle section permits any number of TwinVeyor 50-foot units to be hooked together, forming a continuous line of any desired length. The traveling load hurdles each power head in the line. Right and left spiral chutes are provided for shunting the load from one TwinVeyor line to another without manual handling, thus making right-angle turns simple.

MEASURING ULTRA-VIOLET RAYS

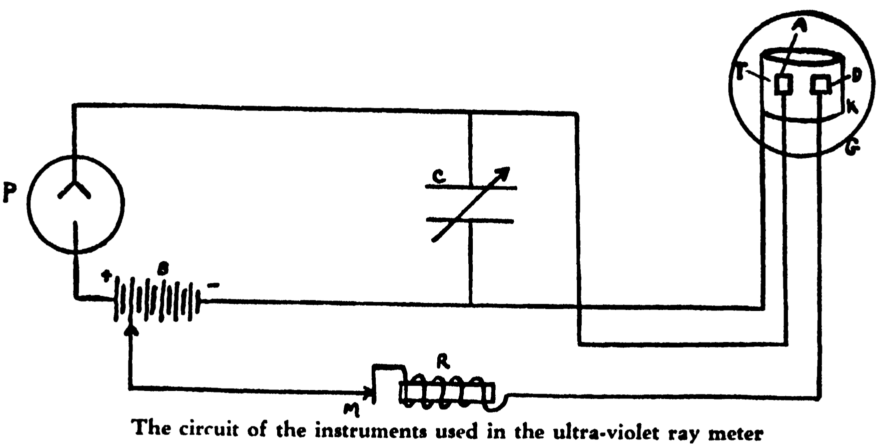
THE element of danger in the indiscriminate use of the ultra-violet ray has had to do with the dosage, the amount of exposure, the proper measuring of ultra-violet radiation for the purpose at hand. It has heretofore been a difficult task to measure this amount exactly, but now there is an ingenious device for the purpose, an ultra-violet ray meter that records the amount of ultra-violet rays coming one's way as accurately as an electric house meter gives the amount of electricity one is consuming in the home.

This indicator operates from dry cells within it. Its essential element, the "eye" of the instrument, is a photo-electric cell which was developed by Dr. H. C. Rentschler of the Westinghouse Lamp Company. The cell in this case is sensitive only to those light rays supposed to have therapeutic value or other effect on vitality—rays .0029 to .0031 millimeters in wavelength. The cell itself is the result of research findings that: (1) By a proper selection of the active material, a cell may be obtained that will not respond to light of longer wavelength than that desired; and: (2) By use of proper light filters it will not respond to light of shorter wavelength than that suitable for the purpose. (A cell of uranium metal and Corex D glass, for example, responds only to that band of light used in prevention and cure of rickets.)



Graphic meter for recording the quantity of ultra-violet on a chart

When the rays strike the cell of the meter, a certain amount of current passes through it, proportional to the intensity of the rays, and charges a condenser which, when fully charged, trips a counter. The operation is then repeated, each impulse measuring a definite quantity, irrespective of the light intensity. Since the unit of measurement has at present no name, the value taken is arbitrary. Over a given period of time the number of impulses per minute, each accompanied by a "click," thus indicates intensity, while the total number of impulses indicates quantity.



The circuit of the instruments used in the ultra-violet ray meter

The principle on which the meter operates is as follows, referring to the diagram: A battery B charges condenser C at a rate determined by photo-electric cell P when light falls upon the cathode. Glow tube G has metal cylinder K for cathode and a primary anode A and main anode D. A small gap exists between A and cathode at T When C is charged to a potential such that a discharge takes place between A and K, the cathode resistance of the glow tube is broken down and current flows between D and K. This operates the relay R, registers the count, and opens the main circuit M. The condenser is discharged simultaneously. The operation is then repeated. The total quantity of light falling on P is proportional to the total number of discharges registered.

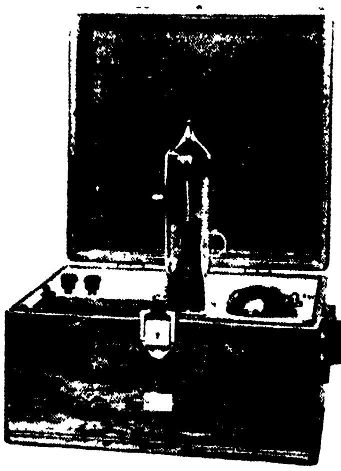
WOOD ALCOHOL

WITHIN recent years it has become possible to produce synthetically the wood alcohol that was formerly prepared only by destructive distillation of wood. The substance is now manufactured from water-gas and hydrogen at a cost which makes it possible to produce large quantities at a low price. Modern industry is, therefore, attempting to introduce the substance for a large variety of purposes, including its use as an anti-freeze mixture in automobile radiators. It is also used in the manufacture of quick-drying shellacs and varnishes. It has long been known that wood alcohol is a dangerous poison with cumulative effects. When taken frequently in small doses, it produces blindness; in large doses, it causes death. The added danger from this product is in the fact that the repeated inhalation as well as the drinking of very small doses of the poison may produce the most serious results.

If this substance is to be used as an anti-freeze mixture in the coming winter, employees of garages who will inhale large amounts of it from overheated radiators are likely to suffer serious injury as a result.

Cases have already been reported in which women and children who have used quick-drying shellacs or varnishes, made with methanol, in closed rooms have suffered harm as a result. In the great spray process used in automobile factories, the spraying is done under hoods and employees wear masks, so that they are protected against the hazard.

As is usual in modern industry, the name of the product has been concealed by the bestowing of fanciful names and the average person does not recognize under the name *methanol* or some other fanciful title the old, old hazardous wood alcohol.—*M. F.*



Ultra-violet indicating meter which uses a special photo-electric cell

FEATS OF SHORT WAVES

RADIO waves which will do the family cooking, provide wireless illumination for homes, alleviate pain, and cure disease are the goal of new investigations into the possibilities of the short-wave high-power vacuum tube, according to Dr. Willis R. Whitney, director of the General Electric Research Laboratories, in a research narrative issued by the Engineering Foundation.

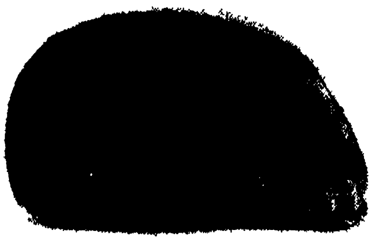
Control of this power for practical uses will immediately open up lines of advance in industry and therapeutics hitherto closed to science, it is stated. Simplified mechanisms and a reduction in the cost of producing large volumes of radio energy are the problems now facing solution.

Radio cooking has already been demonstrated in tests with the new tube.

"A wire was suspended over a table,"

Dr. Whitney states, "at a distance of a few feet from the radiating aerial, which was a copper bar about 10 feet long. A sausage in a glass container suspended from the end of the wire was soon cooked. Likewise an egg was 'fried' in this container, and an apple spitted on the end of the wire was thoroughly baked in a short time.

"With suitable changes of utensils, cookies were baked and water boiled. There were no flames or other visible evidences of heat accompanying the cooking. The vacuum tube from which this weird power emanated was only two feet long and five inches in diameter.



Robert P. Robinson of the Skelly Oil Company, found this stone at San Angelo, Texas. Its resemblance to a human skull is striking, but since it came from rocks of the early cretaceous period, thus making it something like 115,000,000 years old, scientists are not inclined to take its human origin at all seriously

"As yet the high-power short-wave vacuum tubes are being used for experimental purposes only. To bring them into practical usefulness at reasonable cost and discover their many possibilities for service to mankind is now our task."

BLOOD PRESSURE

THE blood pressure of human beings is measured by putting an elastic cuff around the arm, inflating it with air, and then listening to determine the points at which the sound of the blood in the vessels is extinguished and the point at which it again appears when the pressure of the cuff is released. This simple test has been of tremendous importance, particularly in examinations for life insurance. A normal blood pressure is recognized as being approximately 120 millimeters of mercury. Insurance companies insure persons with pressures ranging from 100 to 140.

In order to make some more exact determinations regarding blood pressure of a considerable group under controlled conditions, Drs. W. C. Alvarez and L. L. Stanley took the blood pressure of all of the prisoners in the San Quentin prison in California. They are inclined to believe that there is a normal blood pressure for each person; that if a person has a high blood pressure at 20 years of age, he is likely to have a high pressure at 40. The lower limit of normal pressure they found to be 90 millimeters of mercury and the upper limit 140. They found the normal pressure about 115, which is lower than the figure usually found for men out in the world. The reason for this they consider to be the fact that the prisoners are not fatigued and worried by the struggle to make a living. They did not find that alcohol affected the blood pressure, but tobacco appears to raise it about 4 millimeters.

Men who have been convicted of murder in the first degree showed a blood pressure slightly higher than that of other prisoners of the same age. They found that the prison guards had a pressure considerably higher than those of prisoners, which they consider to be due particularly to overweight, and also to the fact that the guards were applying for positions at the time when the pressures were taken and that many of them were anxious for fear they might be rejected.—*M. F.*

POTATO RUBBER

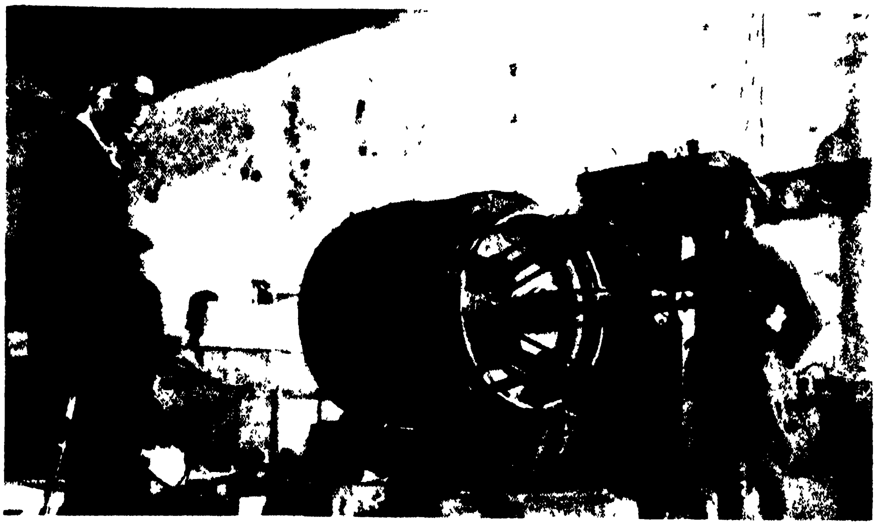
THE Firestone Tire and Rubber Company is experimenting on the commercial value of a new variety of rubber with potato starch as the base. The synthetic product contains no latex or plantation rubber. It is made by mixing the starch with chemicals which coagulate it into a gum-like substance differing from rubber only in that it is less elastic.—*Barron's.*

REFRIGERANTS FROM THE TROPICS

"YOUNG as we are," says Dr. H. E. Howe, editor of *Industrial and Engineering Chemistry*, "we can remember the days when sailing vessels carried cargoes of natural ice from Maine to Cuba, and we believe even as far as Calcutta. How times have changed!

"There is now en route to New York from Mexico one of three vessels, each of which has been equipped with a compartment insulated against heat exchange by 12 inches of cork board to bring solid carbon dioxide to the metropolis for refrigerating purposes. One of the petroleum companies in drilling for oil struck a supply of carbon dioxide which rushed to the surface at a pressure of 1000 pounds.

"It is much too early to discuss the economics of this venture. Inasmuch as the solidified gas must be cleaned of its impurities before it can be re-made into commercially pure solid carbon dioxide, it is doubtful whether the natural high pressure will be of much advantage, and undoubtedly there have been some nice technical difficulties in the purification of this particular supply of gas. We have yet to learn, too, with what efficiency and what percentage of loss the solid gas has been stowed in the hold, transported, unloaded, and distributed. These are technical details concerning which no information has so far been made available. However, the whole venture is intriguing. The mere thought of preparing a refrigerant in the tropics for shipment into the temperate zone is so complete a reversal of the old established practice as to afford another example of how chemistry is helping to remake the world."—*A. E. B.*



Even turbulent Afghanistan, where kings are made and unmade overnight, must have coins. Here is shown the electrical smelting machine, imported from America, which has just been installed in the mint at Kabul, the capital. Beside it stand an army officer and a modern young Afghan "intellectual"

NEW INSECTICIDE PRODUCED BY "CUBE ROOTS"

IT used to be a favorite wheeze at college to suggest to the room-mate who had prematurely squandered his allowance that he write home for funds with which to buy a cosine for use in mathematics class. We used to assume that Dad either had never been exposed to trigonometry or had forgotten that a cosine was merely a mathematical function of an angle and that he would "enclose check" rather than admit ignorance. We were forcibly reminded of that ancient practice by a recent statement in a publication of the staid United States Bureau of Agriculture, when we noticed the sentence "cube roots are not yet available commercially."

We still think Dr. R. C. Roark, of that department, had his tongue in his cheek as he wrote that sentence, but further investigation revealed the fact that "cube" is a South American plant and like most other plants, it has roots. (The plant's name, incidentally, is pronounced koo-bay.) In the course of this reading, we learned further that the cube plant has been found to contain a substance called rotenone which has been found to be an excellent insecticide. The Department is therefore urging the Malay States to grow rotenone-bearing plants on a commercial scale for

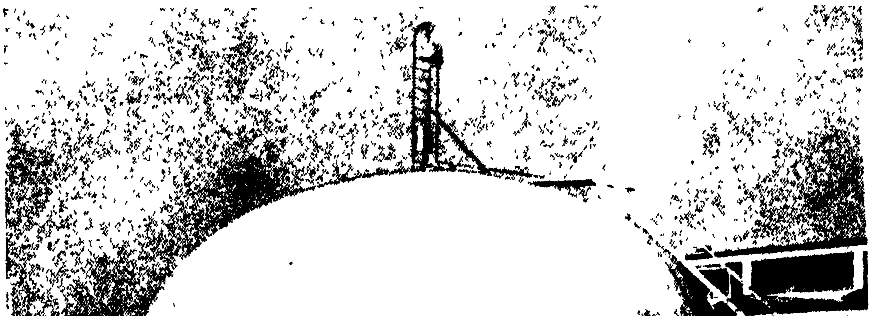
American trade. This new insecticide is found in quantities up to 7 percent in the root of the South American cube plant, up to 5.5 percent in derris roots, and to a lesser extent in three other plants. The cube plant now grows in a part of South America where the climate is similar to that of the Malay States and surrounding countries.

Tests by the Department of Agriculture indicate that rotenone is highly poisonous to both sucking and chewing insects. In tests conducted privately, rotenone was fed to dogs, cats, sheep, and chickens in quantities up to 1 grain per pound of body weight and no injury was noticeable.—*A. E. B.*

KETOGENIC DIET IN EPILEPSY

IN 1921 it was suggested that children with epilepsy might have the number of their attacks greatly reduced by providing them with a diet low in protein and containing large amounts of fat as compared with the amount of sugar taken into the body. This is called a ketogenic diet, because it tends to produce an excessive amount of ketones and their derivatives in the blood and in the excretions. The diet must be carefully watched, since an excessive amount of this substance produces serious symptoms.

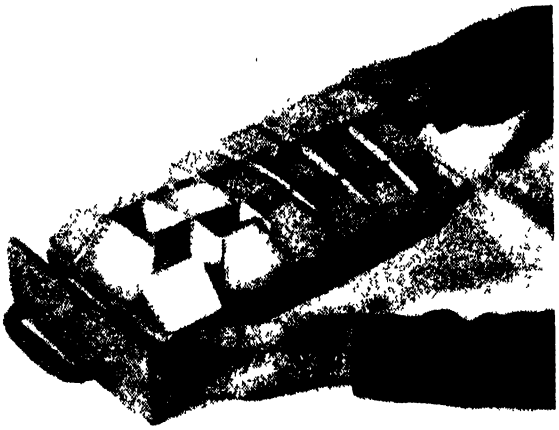
Recently, Drs. Henry F. Helmholz and H. M. Keith have recorded the results of this diet on 272 children who had suffered with epileptic attacks. Two hundred forty-three children with epilepsy of unknown origin, in that the attacks could not be related to any disease or surgical disturbance, were treated by this diet. One hundred seventy-one of these children cooperated fully. One hundred forty-one children had been on the diet more than a year and 30 had been treated less than a year. Of the 141 patients treated for more than one year, 43 patients had remained free from epileptic attacks from one to seven years, and 32 others had shown definite improvement, as evidenced by the decided improvement in the number and severity of the attacks and by improvement in their general demeanor.



Looking like a huge drop of water on some oily surface, this Hortonspheroid holding 10,000 barrels of oil, was built for experimental purposes at Chicago

It has been argued by some observers that dehydration of the body is an important factor in the lessening of the convulsions. The investigators admit that this plays a part, but do not believe that it is the only factor.

Apparently 30 percent of the patients with epilepsy of unknown origin are freed from convulsive seizures by the use of this diet and, under completely controlled conditions, as many as 37 percent may be relieved of their disturbance. It is, of course, impossible to keep such children in hospitals over many years, and it becomes necessary for parents in the home to learn how to handle the diet and to take care of the child properly.—*M. F.*



Ordinary ice cube trays of automatic refrigerators are unsatisfactory because it is difficult to remove one or two cubes without emptying the tray entirely. A flip of the finger, however, is all that is necessary to remove just the number wanted from this new tray developed by the Frigidaire Corporation. It is made of strong rubber on a rigid steel rod frame

CHEMICAL PARADOX LEADS TO BETTER INSULATED WIRE

RUBBER is a non-conductor of electricity. Carbon black is a conductor. Therefore, it would appear natural that the admixture of carbon black in rubber would increase the latter's conductivity. In fact, this has been generally assumed to be the case until W. B. Wiegand and C. R. Boggs, in a recent issue of *Industrial and Engineering Chemistry* disclosed experimental evidence to the contrary. As a matter of fact, up to about 10 percent, by weight, of properly made and dried carbon black may be added to each 100 parts of rubber hydrocarbon present in rubber insulating compounds with marked improvement in dielectric strength, resistivity, and power factor, and without serious increase in dielectric constant of the rubber insulation.

The exact amount of carbon black required depends somewhat on which electrical property is to be brought to its maximum value.

This discovery is of importance to the makers of insulated wire who use a rubber covering next to the metal. In fact, these results would seem to render advisable the rewriting of many specifications dealing with rubber insulating compounds, and thus make it possible to apply the well-known beneficial effects of carbon black compounding—improved toughness, density, wearing resistance, imperviousness to light, tear resistance, and so forth—to the electrical insulation field, from which it has hitherto been barred.—*A. E. B.*

NEW OIL TANK HAS UNIQUE SHAPE

IF you were to visit certain oil company properties in Texas you would see unusual steel structures which have the appearance of giant mushrooms breaking through the ground. They are a new type of storage tank designed by the Chicago Bridge and Iron Works.

The Hortonspheroid, as this unusual shaped tank is called, is used to store high-test gasoline and other volatile oils. Such liquids are placed in the tank and the tank closed tight to prevent evaporation loss taking place.

It is possible to close the Hortonspheroid tight because it is designed to withstand a certain pressure, usually 10 or 15 pounds per square inch. As the temperature rises, the pressure increases but no vapor escapes. Each installation is, of course, equipped with a safety valve.

But why the unusual shape? It is simply the shape which a flexible container would take if filled with liquid and subjected to a few pounds pressure. It is the most natural shape for such conditions and, by the way, the most economical one, as all of the metal used in its construction is used effectively.

SWORD SWALLOWERS

THE sword swallower is able to pass a long knife down his throat by developing a special agility in the movement and by developing also the ability to breathe by movements of the ribs without moving the diaphragm. That fact was recently determined by three French physicians who subjected two sword swallowers to a

Seated within the cabin of a large airplane, the young lady above wears the parachute harness which is covered with a velour jacket. At right, she has snapped the simple parachute hook into the harness ring

physical examination, using both the X ray and the esophagoscope, an illuminating device which enables the physician to look into the tube through which food passes when swallowed.

The use of this device, the esophagoscope, revealed the fact that there were no special abnormalities of the esophagus nor was its lining full of scars as might have been the case if the swords had cut it The evidence indicated that the sword is passed down by making a straight line through the mouth, throat, and esophagus, and that cutting is avoided by holding the diaphragm still in the manner that has been mentioned. In order to be a sword swallower one has to be especially built as well as trained for the purpose.—*M. F.*

A QUICKLY ATTACHABLE PARACHUTE

WITH more and more travelers using aerial transportation, the question of parachutes for passengers in cabin airplanes becomes increasingly important. The Russell Parachute Company has developed a quick attachable parachute which promises to be most useful.

The passenger wears a harness covered by an attractive velour jacket. The velour-faced parachute pack is placed conveniently in a metal rack. The pack can be instantly removed from its rack, grasped by the hand holds on either side and with one quick movement engaged to the single steel hook in the harness breast plate.

The pack is in no wise different from the ordinary Russell 'chute and acts just as efficiently and dependably.—*A. K.*

A ROTOR AIRCRAFT

RECENTLY *The New York Times* published an interesting story on a "rotor aircraft," a photograph of which we reproduce here.

Piecing together the newspaper story and what we can deduce from the photograph of the craft (built mysteriously on a barge moored in Long Island Sound off Mamaroneck, New York) we analyze it as follows:

In the center there is a short fuselage or nacelle in which there are: a tandem cockpit; a Wright Gipsy, 90 horsepower, air-cooled engine used to drive the rotors; and at the front end, another engine driving a conventional tractor propeller with three blades.

The nacelle is mounted on a conventional twin float alighting gear (built by the Edo Aircraft Corporation).

The tail surfaces are not mounted at the end of the nacelle, but are carried by booms and outriggers.

The front engine and propeller constitute the propulsive system, differing in no wise from the ordinary propulsive system.

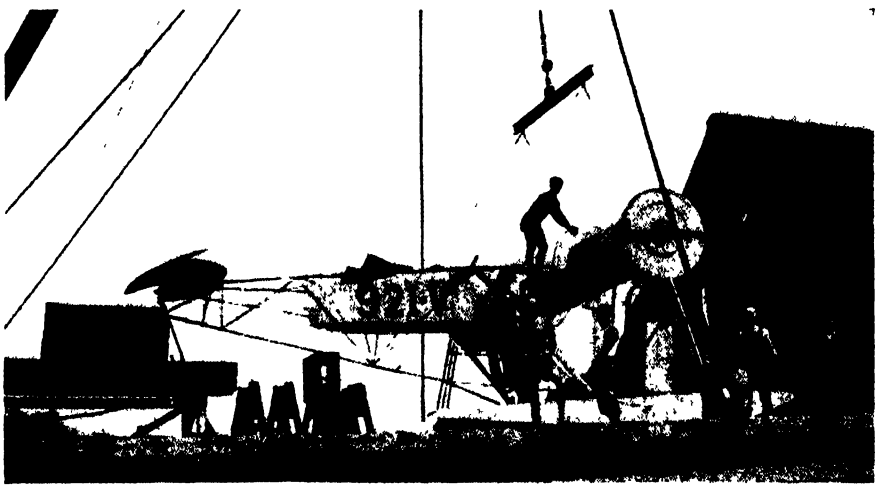
The Wright Gipsy engine, by some species of gearing keeps two large rotors in movement, one on each side of the fuselage. These rotors have a combined span of slightly less magnitude than would be the normal span for a seaplane of this size. The rotors are two feet in diameter and carry sheltering circular disks four feet in diameter at their ends.

At the time of the Flettner visit to America in his rotor driven ship, *Buckau*, there was much speculation as to the possibility of employing a rotor as the sustaining element of an aircraft. Theoretically, there is nothing impossible in this. When a cylinder is rotated in an airstream it experiences a side force of considerable magnitude. The principle of this side force was discovered by a German scientist by the name of Magnus more than 60 years ago. The Magnus principle explains the swerve of a baseball.

If the rotor aircraft is set in forward motion by the pull of the tractor propeller, and the cylinders are rotated so that the upper side is moving into the wind, the force acting on the lower side becomes a vertical or lift force.

For the same projected area of rotor, it is possible to obtain several times the lift of an ordinary wing—perhaps seven or eight times as much. Therefore the projected area of the rotor can be considerably smaller than the area of the equivalent airfoil and it is conceivable that for the same gross weight a more compact sustaining system can be used.

There are, however, two great difficulties to overcome. The ordinary airfoil, when the engine fails, acts very well in a glide. If the Gypsy engine should fail, the rotors ceasing to rotate would be deprived of lift and the craft might fall very rapidly. The other difficulty is one of efficiency. From experiments made by the writer of this note, it would appear that even when a long slim rotor is employed, and large sheltering disks are placed at the ends, the lift-over-drag ratio—the ratio of sustaining force to resistance of the rotor—is only five or six. For a good airplane wing, this ratio of lift to drag may be as high as 20. Therefore high speed and efficiency become difficult of attainment with a rotor as the sustaining element. It is clear that no rotating lifting element can be as efficient as a beautifully cambered wing. Perhaps the mysterious designers are perfectly aware of these facts and have already met the difficulties by advanced research. We shall await further news with real interest.—*A. K.*



Wingless airplane, an adaptation of the Magnus principle on which Flettner's rotor ship operated, on the barge on which it was built in Long Island Sound

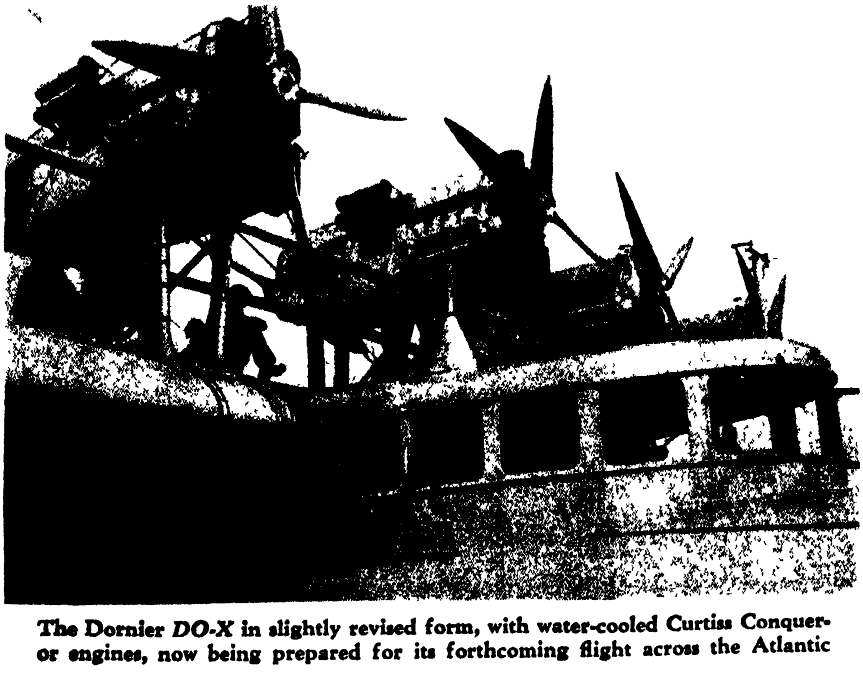
GROOMING THE *DO-X*

THE Dornier *DO-X* is being actively prepared for its forthcoming flight across the Atlantic to the United States. Since its initial flight, the giant flying boat has undergone a number of important changes. In its early form, the power plant consisted of 12 air-cooled Jupiter engines of 475 to 500 horsepower each. The air-cooled engines were disposed in tandem in six nacelles. Some unofficial reports had it that the rear engines did not cool sufficiently well, particularly when taking off from the water. Other reports gave the giant boat a somewhat low performance. The change to 12 Curtiss Conqueror water-cooled engines of 600 horsepower would tend to substantiate the truth of both views.

With the water-cooled engines shown in the accompanying photograph of the *DO-X*, the radiator is in front in the slipstream of the front propeller, and both engines have an equal chance of cooling.

Those who remember the photographs of the *DO-X* published previously in this magazine, will note two other important changes. A small auxiliary wing, placed some four feet above the main wing, formerly connected all the engine nacelles. This wing has disappeared, and there is now but a simple streamline brace running from nacelle to nacelle in its place. Our opinion is that the interference between main wing and auxiliary wing was found to be detrimental to efficiency.

Another change is in the support of the nacelles above the main wing. This used to be in the form of a single gigantic streamline strut. Now this support is in the form of struts and braces of more conventional dimensions. Here, again, the large stream line strut probably diminished the lift and efficiency of the main wing. The large streamline support *per se* may have had less resistance than the present exposed nacelle bracing, but the interference between large strut and wing was another matter. The interior of the cabin has been re-decorated and re-furnished for the comfort of passengers on long flights. The interior now looks as comfortable as the salon of an ocean liner. *A. K.*



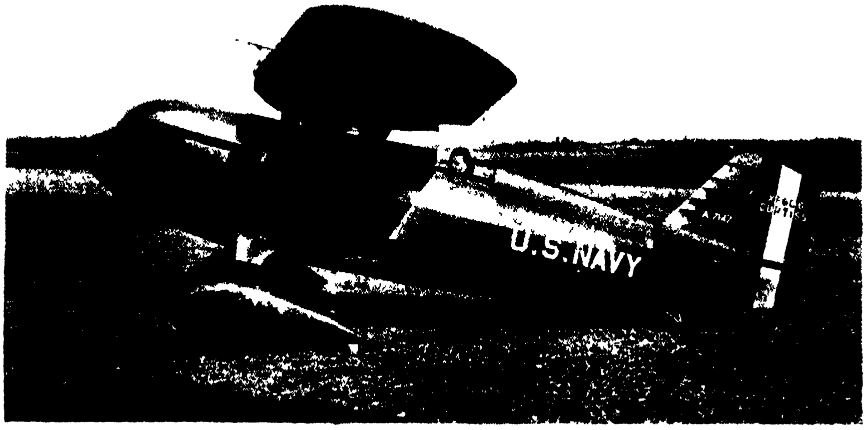
The Dornier *DO-X* in slightly revised form, with water-cooled Curtiss Conqueror engines, now being prepared for its forthcoming flight across the Atlantic

THE SECRET OF AVIATION SPEED

CAPTAIN Frank Hawks, who recently crossed the continent in half a day, is an exponent of aviation speed. To an interviewer of *The New York Times*, he said, "I believe this last trip did prove that an aerial pony express on a 13- to 15-hour schedule between New York and the west coast is practical to-day. Why waste time loafing along at 100 miles an hour when planes can be built to fly 200 to 300 miles right now? Five hours to Miami, 15 hours to the Canal Zone, three to four hours to Chicago. That is the speed for our bankers who must send interest-bearing securities, and that is the speed our designers and engine builders must prepare for and prepare for soon."

The National Air Races at Chicago certainly backed-up Captain Hawks' point of view. This year saw the application of still more power, and also increased refinement in streamlining.

The picture of the re-vamped Curtiss Hawk pursuit plane serves to explain high plane speed. Here is a comparatively small plane, powered with a 600 horsepower Curtiss Conqueror engine. This engine, with tremendous heart, is small of body. It is completely enclosed in the beautifully streamlined body. It is water-cooled, yet we do not see a radiator! That is because the radiator is part and parcel of the wing. The cooling surface is also the covering surface of the wing, with water circulating in a multitude of concealed tubes. Cooling is thus obtained without any expenditure in head resistance. The wheels are streamlined in so-called "pants." There is but one wing, and the strut ends are carefully faired into this wing. The landing gear consists of but two cantilever struts, one on each side. There can be little further refinement in the attempt to gain speed.



Trophy-winning Curtiss Hawk pursuit plane rebuilt for better performance. Most of the features described in the accompanying text are visible in this view

Such aerodynamic efficiency is part of the secret of airplane speed, lightness of structure is another part; and lightness of motor for high power is yet another. But there is one fundamental difference in principle which differentiates the airplane from all other methods of transportation as regards speed.

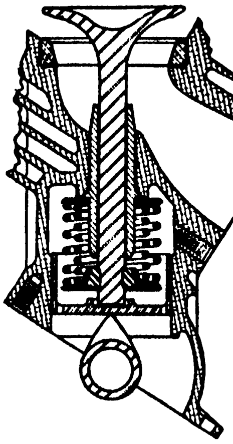
In all vehicles, be they surface vessels, trains, airships, or automobiles, the air resistance goes up as the square of the speed; the horsepower as the cube of the speed. That is why an ocean liner cannot be pushed beyond 30 knots or so, without the use of absolutely prohibitive power.

But in the airplane, the resistance is independent of the speed. It is dependent only on the aerodynamic fineness of the plane. If the fineness is high—if the ratio of lift to drag is 15—then one pound of weight will require only one pound of pull, no matter what the speed. Therefore speed can go up indefinitely. Some authorities claim 500 miles per hour to be the limit, because after that, air friction will set the plane on fire! But 300 miles an hour as a commercial speed is certainly within the limits of possibility.—*A. K.*

AVIATION FINANCES

AFTER the mad, though happy days of 1929, American aviation is suffering from the same depression that other industries are meeting. The President of Air Investors, Harvey Williams, paints a gloomy picture in his report summarizing 1929 and first-quarter-1930 conditions. The most important holding companies are probably United Aircraft and Transport, Curtiss-Wright, and Aviation Corporation. Aviation Corporation reported a first quarter loss of 863,651 dollars as compared with a loss of 1,441,000 dollars for the last six months of 1929. Curtiss-Wright suffered a loss of 1,620,920 dollars as compared with a loss of 668,000 dollars for the full year of 1929. United Aircraft and Transport reported earnings of 39 cents a share as compared with 89 cents for the first quarter of 1929. Inventories are still heavy, smaller manufacturing companies are disappearing, and production is very low. But there is a brighter side to the picture!

Colonel Clarence M. Young, Assistant Secretary of Commerce for Aeronautics, gives a totally different viewpoint in his report to Mr. Hoover.



Unconventional valve mechanism of the new inverted airplane engine

About 18 months ago, 35 companies were operating 59 different scheduled airlines over the airways and were flying a total of 69,000 miles every 24 hours.

At the present time there are 45 such companies engaged in the transportation of mail, passengers, and express, flying approximately 120,000 miles per day. These 15 carriers now operate 137 different routes.

Colonel Young foresees great progress when the provisions of the Watres Airmail bill are given full effect.

The first result under this bill will be the extension of the airmail to various parts of the country not now being served, because it will permit the Postmaster General to utilize the facilities of existing passenger lines.

Second; it will assist materially in the establishment of a more comprehensive passenger service throughout the nation by permitting present airmail carriers to go into the passenger transportation business.

While private flying is still lagging behind, this enormous and rapid growth in transportation will eventually give the manufacturers ample scope. More lines will mean more pilots, hence more students, hence more training planes.

No matter how gloomy the financial statistics of earnings, losses, inventories, assets, and so on, may look, the future of aviation is just as sound as ever. The slump is certain to be followed by a rapidly increasing prosperity of the whole industry. —*A. K.*

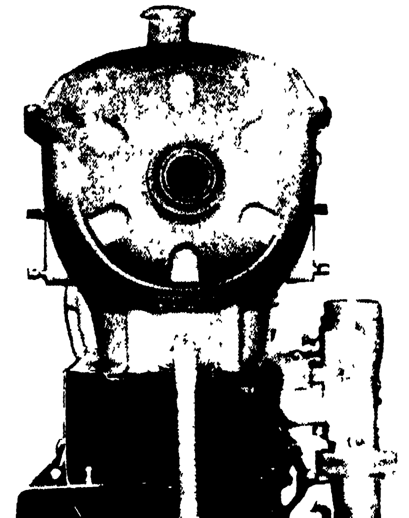
LOUIS CHEVROLET'S AIRCRAFT ENGINE

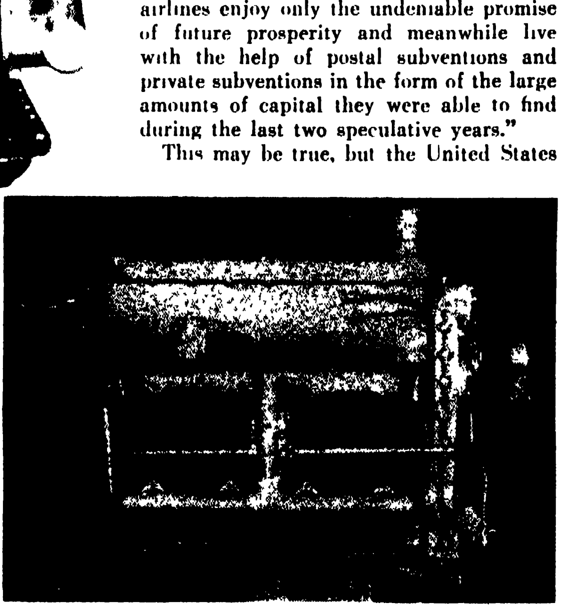
WELL known as the winner of many automobile races and the designer of racing automobiles, Louis Chevrolet has now designed an excellent aircraft engine, the Chevrolet "333." The fashion in low-power motors for aircraft now seems to run to the inverted, cylinders-in-line type, and it is to this category that the 333 belongs. The inverted engine, with the propeller-thrust line at the usual position, gives the pilot the best possible vision forward; the top of the crankcase is well below his eye, and there are no cylinders, exhaust stacks, or other impediments to sight.

The specifications of the 333 are interesting because they indicate that the popular four-in-line air-cooled type of engine is increasing in power and decreasing in weight.

Bore of the 333 is 4.5 inches; stroke is 5.25 inches; and piston displacement is 333 cubic inches (hence the name of the engine). It is rated at 120 horsepower at 2100 revolutions per minute and the weight (dry) is 260 pounds. Fuel and oil consumption is less than half-a-pound per horsepower-hour. (Aircraft engineers never think in gallons of fuel but in pounds, because weight is the important item rather than cost as is the case with the motor car owner.)

The air to cool such an engine must be carefully directed; the front view shows the scoop at the left side of the engine. Because of the special type of head, the cooling air passing through the scoop has no interference from the exhaust stacks—which are below—and strikes directly on the hottest part of the engine.





Above: Front view of the Chevrolet 333 engine showing, as a black square at the left, the scoop which directs the cooling air to the hottest part of the engine. *At right:* Side view of the engine. Looking over the smooth crankcase of this inverted engine, the pilot's vision is not obstructed

The valve mechanism of the engine is unconventional and deserves special mention because the valves are actuated directly through lifter cups of Nitralloy steel. The cams strike the lifter cups a trifle off center, causing each cup to rotate every time it is struck. The valve springs are both wound in the same direction and each time the valve operates these springs have a tendency to twist the valve, thereby equalizing the seat. The entire valve mechanism is in a constant bath of oil and it is claimed that no adjustments are necessary. This should certainly be a great relief to the aircraft mechanic!

The special exhaust outlet enables the stacks to be placed under the engine, so that cooling air is not impeded and the exhaust pipe can be most conveniently located right under the engine. Carburetion is supplied by a Zenith down-draft carbureter. The down draft principle is being rapidly accepted in aircraft practice.—*A. K.*

DO AIRLINES PAY THEIR WAY?

AIRPLANES do not pay their way, according to M. Henri Bouché, Editor of *L'Aéronautique* who presented a formidable statistical monograph to the first International Aviation Conference of the League of Nations.

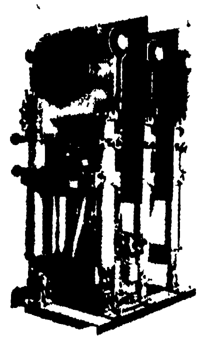
Each mile flown by commercial transport planes in 1929 cost British taxpayers about six dollars for lines going to distant parts of the Empire, and $1.28 for British-European lines. The French taxpayer suffered to the extent of $1.09 a mile, and the German 70 cents. In the United States we are proud of the fact that there are no subsidies to our airlines. But M. Bouché is of the opinion that, taking into account the high rates charged for airmail considering weight, much higher than those paid by passengers—there is an indirect subsidy of about 70 cents per mile flown.

"The great size of the United States, its huge volume of urgent business, and other conditions make it the promised land of commercial aviation, yet even there the airlines enjoy only the undeniable promise of future prosperity and meanwhile live with the help of postal subventions and private subventions in the form of the large amounts of capital they were able to find during the last two speculative years."

This may be true, but the United States is reducing its mail contract rates, new capital is not being put into the industry, and traffic is growing rapidly and steadily. In a very few years American air transport will be an entirely self-supporting industry, which is far more than is probable in Europe.

M. Bouché has found, however, two entirely profitable airlines, both outside of

Whoa, there, YOU IONS...



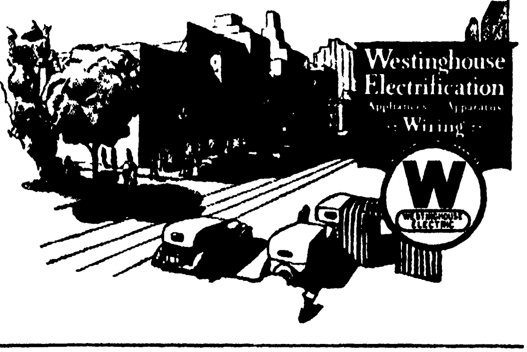
OUT of the mercury arc tube — that odd-shaped bubble of glass with horns at the sides and a pool of quicksilver in the bottom — has come new light on one of the electrical industry's oldest problems.

For years research men had sought to control the arc that flashes between contacts every time a high-power electric circuit is broken. Several methods had been applied with practical results; yet the basic principles of arc formation and control remained unknown.

Then, not long ago, an engineer in the Westinghouse Research Laboratories, while working on applications of the mercury arc tube which demanded accurate arc control, concluded that the impetuous energy of any arc was due to the impetuous ions that compose it. "Harness the ions," he told himself, "and you harness the arc."

So successfully is this principle applied in the new De-ion circuit-breaker that heavy voltages can now be interrupted in open air with scarcely a flash. The electrical industry hails it as revolutionary. Important improvements are effected in a vital class of electrical equipment which the public rarely hears about—yet on which depends that smooth 24-hour-a-day flow of current now taken so much for granted.

Through discoveries and developments such as these Westinghouse research helps to give homes, industry, and transportation more value in exchange for the dollar that buys electric power.



Tune in the Westinghouse Salute over WJZ and the coast-to-coast N. B. C. network, every Tuesday evening.

Westinghouse

Europe and the United States. One is the German Scadta in Colombia, the other the Junkers Company in Persia. Exceptional geographic conditions enable these companies to charge what the service is really worth, namely three to six times the European air rates.

The statistics for 1929 will be very encouraging to American readers. During that year, the world had 137,000 miles of regular airways on which 2000 planes carried 600,000 passengers and 14,000 tons of freight. The United States carried 165,000, or more than one fourth of this number of passengers, and had a scheduled flying mileage of 21,000,000 while the next in rank, Germany, had only 7,000,000 flying miles during the same period.—*A. K.*

STORAGE PLANT REFRIGERATION UNIT

THE science of food preservation, which has passed through a series of marked refinements during the past few hundred years - from the days of spice application to the present era of automatic electric refrigeration - is still very much the object of the engineer's attentions.

An ingenious piece of apparatus that represents another step in the improvement of refrigerating equipment has just been perfected by the Grinnell Company. This device, known as the Unit Cooler, takes the place of the maze of pipe coils that form a regular part of the refrigeration system in milk plants, storage rooms, meat plant storage rooms, warehouse vegetable quarters, and many other commercial rooms that require conditions conducive to food preservation. The dimensions of this cooler are only 18 by 18 by 19 inches, as contrasted to the 600 lineal feet of pipe employed in the old system, and weighs but 300 pounds as contrasted to three tons of pipe coil.

A refrigerated storage room which has no maze of pipes nor any drip of condensed moisture. The automatic refrigerating unit is shown on the wall at left

With the Unit Cooler, an automatic defrosting process is carried on throughout the day. The air in the room is therefore always sweet and refreshing. In addition there is a uniformity of temperature in the room that was lacking in the old system, and that is highly desirable in a commercial installation.

The liquid refrigerant that feeds an automatic refrigeration system is controlled in this apparatus by a new device known as the liquid level control. This prevents an overfeeding of refrigerant to the system.

The small size of the Unit Cooler also makes it applicable to domestic usage. The device may be easily transported from one location to another, a feature which makes entirely feasible a system of household refrigeration and humidification comparable to some of the installations now employed so successfully in theaters and retail stores.

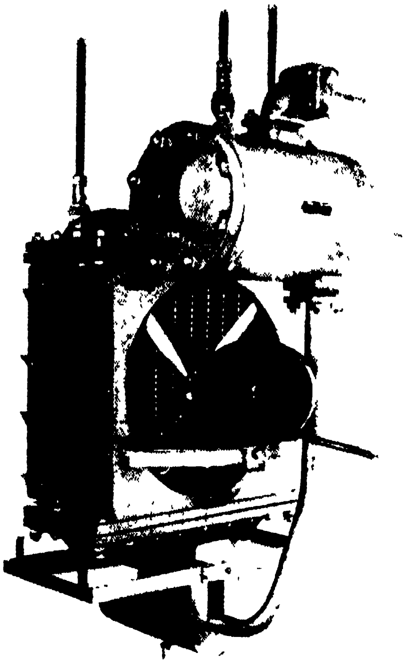
AIRCRAFT PARTS FROM SALT WATER

SALT water is the source of a metal that gives promise of playing a vital part in aircraft construction in the future. The salt brines of Michigan constitute the important raw material for magnesium production in the United States, according to John A. Gann in *Industrial and Engineering Chemistry*.

The natural brine, containing magnesium chloride, is pumped from wells 1200 to 1400 feet deep. By a series of treatments, the other salts in the brine, namely sodium chloride, sodium bromide, and calcium chloride, are removed, and the remaining magnesium chloride is evaporated to a white powder, dried, and finally fused in an electrolytic cell, where the metallic magnesium is made.

The most striking property of this metal is its extreme lightness. With a specific gravity of 1.74, it is only two thirds as heavy as aluminum, one fourth as heavy as iron and, one fifth as heavy as copper. By proper alloying and heat treatment, magnesium alloys are obtained with strength and toughness that permit them to compete successfully with other engineering metals. These properties, coupled with their high specific heat, electrical conductivity, and thermal conductivity, immediately point out many practical fields of application.

Simultaneously with the development of aeronautics has come a demand for metals with a maximum strength and minimum weight. This call was first answered by the light aluminum alloys, and now more recently by the ultra-light magnesium alloys. The more important possible applications in this field include crankcases, oil pans, seat frames, superchargers, instrument housings, control levers, impellers, and pistons. Results to date on both laboratory and flight tests indicate a big development in the forged propeller business. The properties that fit these magnesium alloys for aircraft use are their extreme lightness, high strength, and good fatigue endurance —that is, their ability to withstand repeated applications of stress.



Rear view of entire refrigerating unit showing the fan which plays a stream of air on the cooling pipes

The advantages derived from the use of light magnesium alloys are by no means limited to aeronautics. Distinct improvement in performance has been obtained when using them in many of the reciprocating parts of machinery.—*A. E. B.*

FINDS NERVES MAY CAUSE EYESTRAIN

EYESTRAIN, so-called, is more apt to be the result of "nerves" than of any disease of the eyes, Dr. George S. Derby of Boston told members of the American Medical Association at their meeting in Detroit recently. Dr. Derby described a number of cases he had seen in which the patient recovered from his eyestrain when his bodily condition was treated and when the psychologic cause of his eyestrain was explained and he was persuaded to use his eyes normally.

"If the general public could learn that

eyes are seldom strained, this would be a much happier world to live in," he said. "The fact of the matter is that the eye is provided with a large factor of safety and that healthy eyes do not become diseased even by excessive use."

Most of these cases of ocular neurosis, as Dr. Derby called it, are found in sensitive nervous persons. Fear is the commonest factor in these cases. Some ocular pain or discomfort makes the patient afraid that he is injuring his eyes permanently, that he cannot continue his occupation and perhaps will become dependent. Many of Dr. Derby's patients had given up their work and many pleasures, and were devoting themselves to resting their eyes as much as possible.

Dr. Derby asked opthalmologists not to overlook the psychologic factor in causes of eyestrain, and to treat the mental condition of their patients as well as to correct their vision with eyeglasses.—*Science Service.*

DIAMOND MATCH 9 FOR 1 SPLIT-UP

A PLAN for recapitalization of the Diamond Match Company provides for the formation of a new company with a capitalization of 1,000,000 shares of 6 percent cumulative participating preferred stock of 25-dollar par value and of 1,500,000 shares of no-par common stock, this stock to be distributed to present shareholders at the rate of five shares of preferred stock and four shares of common stock for each share held. In addition, if the plan is approved, a dividend of 25 dollars in cash will probably be declared prior to the transfer of the properties, good will, and business of the Diamond Match Company to the new corporation.

Stockholders were asked to deposit their stock with the Bank of America (N.A.) or Continental Illinois Bank and Trust Company on or before October 15.—*Barron's.*

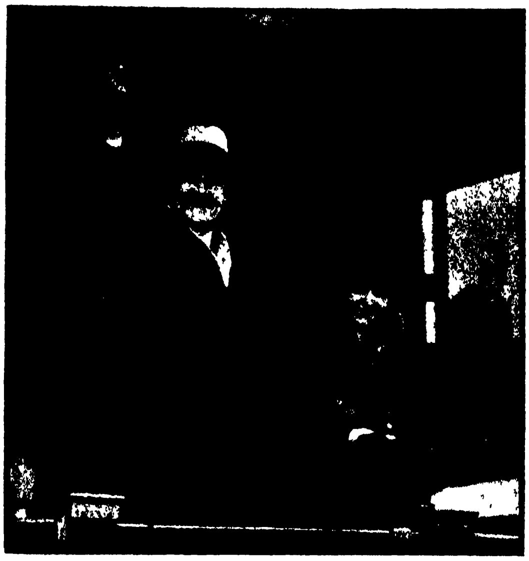
10,000-DOLLAR RADIO IDEA CONTEST

WITH the opening, on September 25, of the Westinghouse Radio 10,000-Dollar Idea Contest, the Westinghouse Electric and Manufacturing Company extended to all America an invitation to join its cabinet designing staff. At that time, the company opened a nation-wide suggestion box with an offer of prizes totalling 10,625 dollars as an incentive for offering ideas for cabinets.

Anyone may compete except employees of the Westinghouse Electric and Manufacturing Company. The contest closes December 24, 1930, and all ideas must be in the mails before midnight December 24. The winners will be announced January 19, 1931.

The rewards for which those who accept the invitation and join the Westinghouse Radio "Idea Department" will compete, range from the first prize, a trip to Europe with all expenses paid or 5000 dollars in cash, to 25 prizes of 25 dollars each; and include between these limits the second prize, a 2000 dollar automobile of the winner's choice or 2000 dollars in cash; the third prize, a 1000-dollar check; five prizes of 200 dollars each; five prizes of 100 dollars each; and 10 prizes of 50 dollars each.

How to provide a RETIREMENT INCOME for yourself



Say good-by to money worries forever

THIS new Retirement Income Plan makes it possible for you to retire at any age you wish, 55, 60, or 65. You may provide for yourself a monthly income of $100, $200, $300, or more.

Suppose you decide to retire on an income of $200 a month when you are 60. Here is what you get:

1. An income of $200 a month, beginning at age 60 and lasting the rest of your life. You are assured a return of $20,000, and perhaps much more, depending upon how long you live. If you prefer, you may have a cash settlement of $27,000 at age 60 instead of the monthly income.
2. Upon your death from any natural cause before age 60, your wife or any other heir you name receives a cash payment of $20,000. Or if preferred, your wife receives a monthly income for life.
3. Upon your death from accidental means before age 60, your wife or other heir receives a cash payment of $40,000. Or if preferred, your wife receives a monthly income for life.
4. If serious illness or accident stops your earning power for a certain period, you will thereafter receive an income of $200 a month during such disability, even if it lasts the rest of your life.

How much does it cost?

A Retirement Income is paid for in small installments of only a few dollars a month. The exact amount depends on (1) Your present age (2) The age at which you wish to retire (3) The amount of monthly income you will want.

One of the great advantages of this Plan is that it goes into operation the minute you pay your first small installment. Even though you should become totally disabled, you would not need to worry. Your installments would be paid by us out of a special reserve fund.

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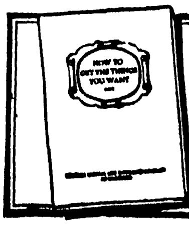

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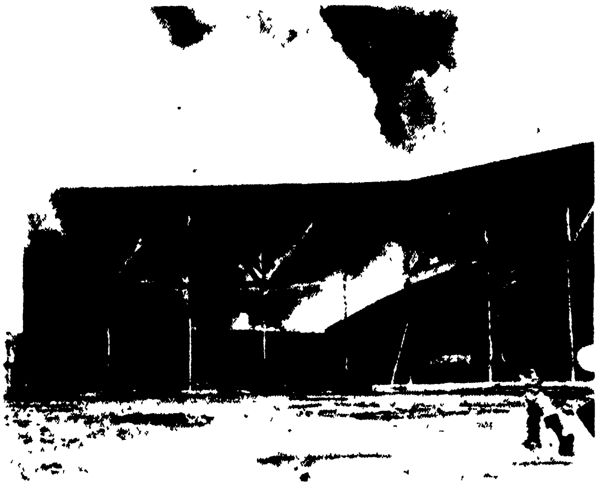

***Above, left:* Fire in a lacquer dip tank and drain board, such as is used for finishing automobile parts**

***Above, right:* Foamite is being released automatically, and is starting to smother the roaring flames**

***Right:* The dangerous fire entirely subdued. This photograph was taken 28 seconds after the one at the left above**

These prizes will be awarded to those submitting the best 48 original and acceptable ideas for beautifying radio cabinets. If a winning idea is submitted by more than one person, the full prize will be awarded each contestant. All prize winning ideas will become the property of the Westinghouse Electric and Manufacturing Company.

It will not be necessary to submit drawings of the ideas one enters in this contest—a written description is all that will be required; however, sketches may be submitted if desired, in which case they should be accompanied with explanatory text. A person may submit as many ideas as he wishes; each suggestion should be on a separate sheet with the originator's name and address.

The judges for the Westinghouse Radio Contest will be: Miss Helen Koues, Director of Good Housekeeping Studio; Miss Neysa McMein, famous artist; Miss Rosamond Pinchot, prominent actress; Raymond Loewy, famed Parisian artist and designer, E. B. Ingraham, Vice-President, Times Appliance Company, Inc., New York City; and A. W. Robertson, Chairman of the Board, Westinghouse Electric and Manufacturing Company.

Contest entry blanks and leaflets giving helpful suggestions for conceiving acceptable ideas are available at any Westinghouse radio dealer's store.

Ideas should be mailed to Westinghouse Electric and Manufacturing Company, Radio Department, 150 Broadway, New York City.

TOILET WATER DERMATITIS

THE intricacies of modern civilization have brought new diseases and unusual hazards into modern life. However, the use of cosmetics seems to go back to the beginning of woman's vanity, and certainly that was the beginning of woman herself! Among the most frequently used cosmetics are toilet waters. Recently specialists in diseases of the skin have been seeing occasionally cases of unusual pigmentation or brown streaks running down the back of the neck. The cause of these unusual disfigurations was not understood until a specialist discovered the relationship between pigmentation and the use of eau de cologne.

Freund applied eau de cologne to the forearm of a boy and exposed this surface to the sun and to sea water. The boy developed inflammation of the skin with pigmentation. The investigator then asserted that the offending ingredient was chiefly oil of bergamot. He then rubbed oil of bergamot on the forearm of the boy and obtained the same result. Since that time numerous cases are being reported by physicians to whose attention they have come.

There are, of course, other instances in which the ingredients of perfumes and toilet waters produce irritations and pigmentation without exposure to sunlight. In these instances there is a special sensitivity which manifests itself immediately after the perfume is used. The oil of bergamot is, however, the substance primarily responsible for the special form of irritation with pigmentation that is now called "toilet water dermatitis."—*M. F.*

CHEMICAL TRICKS WITH SUGAR LUMPS AND LACQUER

WE were eating luncheon together the other day, a fire-prevention engineer and a mere chemist, the latter hoping to pick up some novel kink in the spectacular science of fire-fighting to pass on to SCIENTIFIC AMERICAN readers through these columns.

"Speaking of fires," said the specialist, "did you ever try to burn sugar?" And taking a lump from the sugar bowl he applied a match. The sugar melted but did not burn. At his invitation, we tried to ignite another lump with the same results.

"Now," announced our friend, impressively, "I will make a few magic passes over this same lump of sugar and behold it burns, readily, and even fiercely."

"Marvelous!" we applauded. "How did you do it?"

Pressed for the explanation, the student of conflagrations explained that he had surreptitiously touched the corner of the sugar lump to some cigarette ashes after which it immediately caught fire. Having satisfied ourselves that a tiny smudge of cigarette ash "did the trick" every time, we began speculating as to the chemical cause of its action. After some high-spun theories had been hazarded, the expert explained that any salt of potassium seems to work the same way and that the ashes induced the flame simply by virtue of the potash they contain. This seemed sufficient explanation to our informant, so we refrained from the question which we longed to ask—why does potash induce burning? We were pretty sure he didn't know why because the only explanation we've ever heard is that the potassium acts as a catalyst, promoting oxidation and combustion. And we didn't want to embarrass our friend, lest he might neglect to give us the "story" we wanted. As proof that our tact was fruitful, we reproduce herewith three exclusive views of a recent spectacular test of a modern Foamite fire extinguisher.

The conflagration was started in a large dip tank and drain-board, such as is used in automobile factories for dipping such parts as mud guards into the highly inflammable enamel. One photograph shows the blaze gaining headway and threatening the complete destruction of the "factory." In the second one, the automatic foam engine has begun to apply a blanket of thick "suds." The last one shows the blaze completely subdued, just 28 seconds after the Foamite application began.

All of which would indicate that the fire prevention engineer is adept in the magic of chemistry applied either to sugar lumps or blazing enamel.—*A. E. B.*

GREATEST AERIAL BEACON RIVALS SUN

THE Lindbergh beacon, the most powerful aerial light ever erected by man, has been installed on a tower on the Palmolive Building, 602 feet above the city streets, to guide fliers to Chicago.

Equivalent to a half inch section of the sun and hypothetically equal to the brilliance of two billion half-inch candles set side by side, the lamp has a visible light beam of 500 miles, lighting engineers declare. They point out that while two billion candles would occupy the area of a city block, this amount of light is concentrated in a 60-inch carbon lamp weighing a little more than a ton.

While the light's beam is visible 500 miles away, at this distance, because of the curvature of the earth, it is at an altitude too great for airplanes to reach. For practical purposes, the authorities estimate the greatest visible distance to be 300 miles from Chicago.

This beacon, dedicated to Colonel Charles A. Lindbergh by its donor and designer, the late Colonel Elmer Sperry, inventor of the gyroscope, is defined as a monumental product of modern electric light engineering science.

ASBESTOS INFLAMMATION OF THE LUNGS

WHILE the asbestos industry is more than 2000 years old, it has only within the past few years taken a prominent place among the great industries. With the development of the industry, physicians have begun to notice cases of extensive fibrous changes in the lungs due to the inhaling of the asbestos particles and inflammation of the lungs set up by the particles. When the material is taken into the lungs, it can be found in the tissues in the form of black particles. Similar particles are to be found in the sputum of the patient and indicate to the physician the source of the disorder. Drs. K. M. Lynch and W. A. Smith have described several cases in which these asbestosis bodies were seen in the sputum when the sputum was studied under the microscope. By the use of proper stain methods, they are given prominence. Thus there is provided for the scientific physician who is confronted with such a case a certain method of diagnosis.—*M. F.*

ELECTRICAL CONDUCTIVITY AT LOW TEMPERATURES

THE property of super-conductivity—that is, the disappearance of electrical resistance at very low temperatures—which has been discerned for lead, mercury, tin, iridium, and thallium, has been found by German investigators to apply to the carbides and nitrides of heavy metals. Thus the critical temperatures under which the resistance disappears is 9.3 degrees absolute for tantalum carbide. It appears possible

(*Please turn to page* 402)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

NOW that cold weather is peeking round the corner, amateurs soon will be ready to hibernate in cellar workshops, taking with them two disks of plate glass, some abrasive, and some pitch, to see what kind of a telescope can be knocked out of these "makings." This month, then, we reproduce, by way of inspiration, a number of descriptions of jobs already done by amateurs who found that the practical working instructions in the SCIENTIFIC AMERICAN book "Amateur Telescope Making" actually did instruct.

A. E. PARKE, 6453 Oliphant Avenue, Chicago, sends in a snapshot and says. "This is our first telescope which our boys and myself have just finished, a six-inch reflector which has turned out very satisfactorily. The craters on the moon and the moons of Jupiter are very distinct with a half-inch eyepiece. We have not yet had a chance at the other planets. The figuring of the mirror developed with very little trouble, and we have a total absence of color or distortion. Our mounting is made of pipe fittings on a wooden tripod and works very well. We have learned much in making this one and hope to have a still larger one."

A. E. Parke and his telescope

FRANKLIN B. WRIGHT, 155 Bret Harte Place, Berkeley, California, says: "While gazing at the Milky Way in the high Sierras I resolved to have a good portable instrument next time. The result is shown in the enclosed snapshot. It consists of a 60 millimeter (2⅜ inch) Bausch and Lomb objective costing 30 dollars, about nine dollars' worth of brass tubing and about six dollars' worth of wood, bolts and springs and other odds and ends for the mountings and tripod. Since I have no machine tools the mounting is designed to be made with nothing but ordinary tools which everybody has around the home. The bulky-looking counterweight consists of two old Chevrolet brake drums bolted together. It is adjustable in a wooden slot underneath."

Franklin B. Wright's refractor

E. LLOYD McCARTHY, 10 Powers Street, Canton, New York, a college student, sends in a photograph which shows that times have not changed since days we fondly recall; for the picture gives evidence that Sophomore McCarthy demolished a bridge in order to get a suitable pedestal for his telescope. Here is what he writes:

"The telescope has a six-inch mirror of 46 inch focal length; a one-inch prism; and a half-inch eyepiece. The mirror was polished on a lap of honeycomb foundation after failure with tempered rosin.

"That cast-iron base once did duty holding up a bridge railing. The bearings and axes are pipe fittings; the counterweight was made by casting a calculated amount of lead on a length of pipe. Two semicircular pieces of eight-inch strap iron grip the tube at its center of gravity.

"I have had some good 'shots' at four of Jupiter's moons as well as its belts; our own moon; and terrestrial objects. The other day I lectured about my telescope to one of the physics classes at St. Lawrence University, where I am a sophomore. Judging from the questions and comments afterward, about half of the class want to build telescopes of their own."

TURN now to page 71 of "Amateur Telescope Making" (the second, or 1928, edition) and you will see a telescope made by H. O. Bergstrom. Since then this enthusiast, who is a locomotive engineer at North Platte, Nebraska (P. O. Box 491), has turned out another—two more in fact, but one of the pictures he sends is out of focus so we can't reproduce it.

"Though it's a long time since you have heard from this 'T. N.' my enthusiasm in the work hasn't waned a bit," this Casey Jones (we'd like to ride behind him) writes. "I'm enclosing two photos. One of them is another six-inch reflector; the other is the eight-inch glass shown in the July 1928 number of SCIENTIFIC AMERICAN, with the mounting reconstructed. The equatorials for both these telescopes have a special 'North Platte type' quick-setting slow motion control, a real luxury for the amateur. The mount for the six-inch glass is made from an old cistern-pump stand and two Ford front wheel hubs. The other mount is made up of 'pump-stand' 1½ inch pipe fittings and two Ford transmission drums. The little 'star' standing by the six-inch glass is Marjorie Castell, aged four.

"I'm still at work on an eight-inch Cassegrain but on account of having very little leisure time the progress is slow.

"I have received quite a number of requests for a description of my earlier telescope, since it was published in the SCIENTIFIC AMERICAN. A few requests are still straggling in. Requests were received, among others, from Canada, Cuba, Australia and Java."

WRITES Paul W. Spain, 226 Seventh Avenue, North, Nashville, Tennessee: "Well, I finally got it finished. It is rather

McCarthy's "bridge type" mount

Engineman Bergstrom's telescope

crudely done, but I think it will do for a starter. The Foucault shadows were very well defined, however. I used a frosted 40-watt light in testing, and found that it gives a much better light. I was successful in my silvering the first time, probably due to beginner's luck. The tube is an old stove pipe found in a nearby junk pile.

"I am now planning a ten-inch reflector, with setting circles. The labor is certainly well repaid that is put into a telescope."

THE descriptions given above pertain to typical telescopes made by the average amateur bitten by the bug. We have on hand for publication a number of others, and these bread-and-butter jobs will be sprinkled in, as it were, with a variety of more out-of-the-ordinary things. For example there is a water-clock drive (and it actually works, too) by the old-timer Harold Lower; a telescope made in Australia; a 16-inch reflector mounted on giant sized pipe fittings; the new "milk pail" mounting discovered in Detroit; a circus telescope (Chrysanthemum our cynical office cat says they all are, but she doesn't know); a 12-inch Cassegrainian by Porter which is so smooth looking you'd want to take it to bed with you; also a 21-inch Cassegrainian by England's leading amateur, J. H. Hindle.

Paul W. Spain's Number One

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DO you smile at the people who thought the earth was flat? Are you contemptuous when you read how—when Galileo proved that light bodies fall as fast as heavy ones—people shrugged and called his experiments foolish?

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THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 399)

that compounds exist in which the critical temperatures are still higher. At present this matter is entirely of scientific interest, since it does not seem to fall within the horizon of practical utilization as yet.—*A. E. B.*

FINGER NAILS IN TUBERCULOSIS

SHERLOCK HOLMES and other observant detectives remarked frequently on their ability to judge the character of the individual by his finger nails. A white line across all the nails is usually an indication that the person has been quite sick for some time.

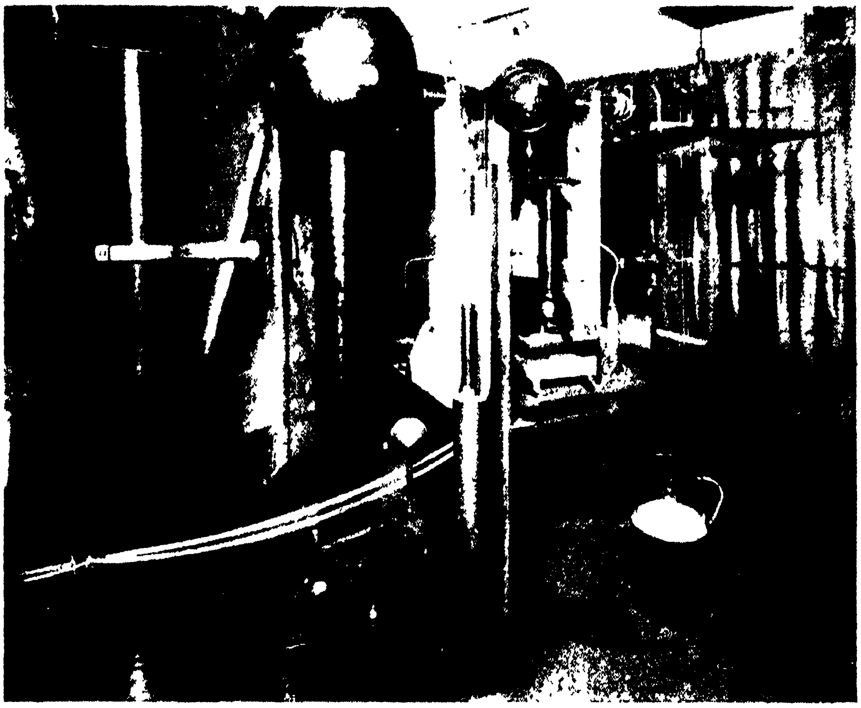
Dr. A. G. Hahn of the Trudeau Sanatorium made a special investigation of patients in that institution, and found that every one of fifty patients with active tuberculosis had pitting of the finger nails. This condition occurred in only three out of fifty patients with inactive tuberculosis, and was not found in any person who was normal. The pitting or depression appeared in the visible part of the nail about six weeks after the onset of the severe symptoms of the disease. The pits were found more often in the nails of the index and ring fingers and do not appear uniformly on the toe nails. Once the pits have appeared they naturally grow forward with the finger nail and are removed during manicuring.

More than 300 years before the Christian era, the school of Hippocrates mentioned the fact that downward curving of the nails was present in tuberculosis. Doctor Hahn found that normal people did not show such curving, 30 percent of the ex-patients had the condition, and 76 percent of the patients with active tuberculosis had downward curving nails.—*M. F.*

MAKES WELDS AIR-TIGHT BY ELECTROPLATING

AN interesting application of electrochemistry to a problem in steel welding is recounted by J. B. Calva in a recent issue of *Chemical and Metallurgical Engineering*. In building a tubular evaporator, the tubes were welded to the headers by the electric process, but on testing it was found that while the joints were mechanically strong, they were not air-tight, because of the presence of many minute capillary tubes produced by the electric arc.

Since this particular evaporator was intended to operate under a vacuum, it was necessary to make these welds air-tight. Caulking the joints proved vain. The next experiment was to induce the clogging of the capillaries with rust by promoting oxidation in their walls with a solution of ammonium chloride. This treatment also failed. Finally, a permanent remedy was applied. Around each of the welds, and concentric with the tubes, rings made of round structural iron, ¼ of an inch in diameter, were placed. These rings were held in place and insulated by means of small pieces of rubber which were compressed between the iron rings and the projecting ends of the tubes. The rings were then interconnected by means of copper wire and a water-tight wooden cover was



Recent experiments by Prof. J. S. Long of Lehigh University may procure for linseed-oil paint the same quick-drying properties as modern lacquers. The work has been conducted with the huge cathode-ray machine illustrated above. The rays from this tube were focused on samples of linseed oil for various periods and it was found that paint made from oil that had been "bombarded by electrons" for 10 minutes dried in half the time required for ordinary paint. The photograph shows the cathode-ray machine adapted for further experiments on the so-called drying oils. It is placed in a special room, the walls of which are completely covered with sheet lead to prevent the escape of the cathode rays

bolted to the flange. A piece of copper wire connected to the rings was made to pass through a rubber stopper which fitted a hole in the wooden cover.

An electrolyte made up of ferrous chloride, calcium chloride, and water was then poured into the tubes and in such an amount as entirely to keep immersed in it all the iron rings and welds. The electrolyte was kept as hot as possible by means of a steam coil.

The electric welding machine was then adapted for electroplating work by inserting in the magnetic field of the generator a slide-wire resistance. This was done in order to reduce the voltage at the terminals of the generator so as to limit the current to a density of 15 to 20 amperes per square decimeter, calculated on the effective surface of the iron rings.

The positive terminal of the generator was then connected to the copper wire coming from the iron rings and the negative terminal to the evaporator. After 24 hours of electro-deposition of iron on the welds, the evaporator was tested and the maximum expected vacuum was obtained.—*A. E. B.*

USE FLUE GAS TO PREVENT DUST EXPLOSION HAZARD

So many forms of dust are highly explosive that methods of preventing this hazard have long engaged the attention of chemists in the United States Bureau of Agriculture. One of the expedients they have developed is the use of an inert gas as the atmosphere to surround grinding operations and others that are apt to produce dangerous dust.

Such installations have been made at two hard-rubber grinding plants, a cork grinding mill, and a pyrethrum-flower grinding plant. A number of sulfur-grinding mills have adopted this method of preventing explosions, and a feed-grinding plant in the middle west is now installing one of the largest inert-gas systems in the country. The use of inert gas to provide protection in one of the large starch plants is being considered, and experiments are under way to develop methods of properly cleaning and conditioning the gas for such use. Fire extinguishers filled with inert gas under pressure, instead of chemicals, are now being produced and are finding a ready market in this country.

Methods of cleaning and conditioning flue gas to render it satisfactory for use as a preventive of dust explosion and fires are now being developed.—*A. E. B.*

SPRAY PAPER MULCHES TO AID CROPS

The use of mulch paper for covering the fields between furrows in order to help the soil retain moisture and to prevent the growth of weeds has been described previously in these columns. An interesting variation of this new idea is being tried out in Germany. Instead of covering certain crops with paper sheets, as is customary in America, a paper coating is sprayed on the fields.

The action of paper coverings results in many cases in a greatly increased production of certain crops, because the soil temperature is increased, weeds suffocated, pests destroyed, and the soil bacteria activated. The paper spray is said to be cheap, cannot be removed by the wind, and is not dissolved by rain. Its most obvious advantage over the use of paper in sheet form is its ease of application. What the effect on the growing plant will be has not yet been determined.—*A. E. B.*

PNEUMONIA FROM INHALING GASOLINE

Experimenting, boylike, with a rubber tube and the gasoline tank of an automobile, an eight-year-old lad got an unexpected dry cleaning of his lungs, which resulted in pneumonia, when his companion blew on the other end of the tube. The case was recently reported to the American Medical Association.

When the other end of the tube was blown into, the gasoline was forced into the boy's mouth. He choked and had a severe strangling spell, from which he recovered, but pneumonia developed. For four weeks he could taste gasoline and it could be smelled on his breath.

Gasoline is rapidly absorbed by the lung tissue, the report stated. The pneumonia that follows this absorption is not typical. The fever is not high and the rapid breathing continues for a long period. The inflammation of the lungs does not remain in one spot, but wanders about, suggesting that the gasoline fumes also wander about in the lung tissue, setting up inflammation in other spots.—*Science Service.*

TIMING A FLASH OF FLAME

The factors that contribute to the propagation of explosions in gaseous mixtures are being studied by the United States Bureau of Mines. This is part of the Bureau's investigation of the mechanism of mine explosions. No matter how long the column of an explosive gas mixture may be, the speed of the flame, when initiated, is accelerated rapidly until it reaches a maximum and constant velocity. The term "detonation" is applied to this type of explosion. So fast does the flame front travel that it sometimes reaches the high value of 10 times the velocity of sound, or over two miles a second.—*A. E. B.*

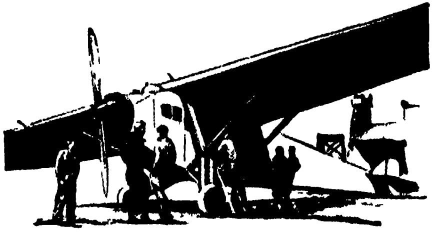
NEW PRODUCT PRESERVES AND IMPROVES GLUE

When the organic chemist begins to juggle atoms, tacking one here and another there on some molecule with a mouth-filling name, no one, including himself, knows what kind of a substance is going to result or what use it may prove to have. Thus, during the past year, chemists of the Dow Chemical Company, Midland, Michigan, have developed, from the laboratory stage to actual commercial production, a new product known as orthophenylphenol. Now what is this substance good for?

Well, being a relative of carbolic acid, one might suspect that the newcomer would be useful as a germicide, but we'll give you 999 guesses as to where it has found application. Answer: In making glue!

The problem of glue preservation, both from the standpoint of preventing mold and that of eliminating putrefaction, has been of extreme importance to both glue manufacturers and glue users. The sodium

"*how* can I get into Aviation?



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IF YOU read "The story of Anesthesia" by Dr John H Evans in the November issue of HYGEIA, the Health Magazine, you may pause at the tale about the above bill and say, "Them was the good old days". But that first rude experiment is a far cry from the perfected science of anesthesia as surgeons administer it today At some time in your own life, either because of an operation on yourself, a member of your family or a friend, you will be personally interested in some kind of anesthesia. Read Dr Evans' story of ether and laughing gas in the "good old days". Let him tell you about the wonderful development of perfected anesthetics in "these still better days" Let him put you right regarding the various kinds of anesthesia

"PHYSICAL ILLITERACY" what is it?

Do you get your exercise listening to the base-ball reports over the radio or sitting in the bleachers watching a football game ? This form of exercise is so common to all Americans that it has been given a name—"Physical Illiteracy" Dr J E Rogers points out the grave danger of physical illiteracy upon your individual health, the health of your family, community and country Read this article in the November HYGEIA

OTHER VITAL HEALTH ARTICLES in the November HYGEIA

"Perception" by Dr. William J Mayo, ***"April Blue"***, a child's health story, ***"How to Protect Your Children from Tuberculosis"***—these are only a few of the additional health attractions treated in the November HYGEIA The articles in HYGEIA are written by health authorities in a charming, non-technical style, pleasing to the layman, who can be sure that the variety of health topics presented are scientifically true HYGEIA is for every member of the family Take advantage of this special introductory offer to get acquainted with HYGEIA The regular subscription price is $3 00 a year, but new subscribers are offered the special get-acquainted-price of $1 00 for six months

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salt of this phenol is water-soluble in all proportions and, regardless of its high phenol coefficient, is reported by bacteriological laboratories as being non-toxic to humans. The quantities necessary to use are exceptionally small; 0.5 percent of sodium orthophenylphenate by dry weight has proved in all tests a complete control against both mold and putrefaction.

The measured strengths of glue have shown that in quantities from 0.1 percent to as high as 5 percent, sodium orthophenylphenate has in all cases increased the strength of the glue and at the same time has given it a slightly bleached effect which is considered very desirable.—*A. E. B.*

"GALAGUM"

GALAGUM is the name given to a mixture of modified polysaccharides recently introduced and described in *Industrial and Engineering Chemistry.* It is a white powder, tasteless and odorless, and acid in reaction. It can also be obtained in a neutral modification. Galagum, when boiled in water, forms colloidal solutions of different viscosities, depending on concentration. A 1 percent solution forms a syrupy solution, a 5 percent solution forms a paste or jelly.

Neutral Galagum is edible and is used in making bakers' and flavoring emulsions. In the cosmetic industry viscous aqueous solutions are much used in lotions and hair preparations. These are produced by dissolving 1 to 4 parts of Galagum in 100 parts of boiling water.

In the baking industries it has been found that neutral Galagum replaces part of the eggs ordinarily used. In the manufacture of ice cream, neutral Galagum decreases the amount of gelatin required Certain cheeses which are made with various protective colloids to give them smoothness and body may likewise be made with neutral Galagum.

Technically, Galagum possesses interesting properties in that it may be used for giving a heavier body to water paints, sizes, glue, and many other aqueous solutions. —*A. E. B.*

RESPONSIBILITY FOR TYPHOID FEVER

TYPHOID fever is carried principally by contaminated food and water and by carriers of the disease whose excretions get into food and water. From time to time brief epidemics have occurred in this country due to the fact that sewage has gotten into the water supply. An epidemic occurred in Salem, Ohio, several years ago, when there were several hundreds of cases. Small epidemics have also occurred in factories where the drinking water became contaminated by sewage.

In Lyons, France, recently the court held the water company responsible for the illness and death of various citizens who had become infected with typhoid fever from contaminated water. Moreover, the court declared Mr. Mercier, director of the water works, to be guilty of involuntary homicide as a result of his imprudence, negligence, and infraction of the regulations. They sentenced him to one year in prison, with suspension of execution, and they fined him 500 francs. Some of the people who developed typhoid fever were awarded damages ranging from 20,000 to 100,000 francs.

The epidemic originated from two wells which were contaminated by the water of a sewer. In its decision, the court maintained that it is the duty of the water distributing company to guard the purity of the water that it distributes. The monthly analyses made by the company were inadequate, and the company should not have ignored the dangers associated with the proximity of a sewer to the water supply.—*M. F.*

VARIATIONS IN SUSCEPTIBILITY TO DISEASE

IT has long been known that different races vary in their susceptibility to various disease. Centuries of infection with syphilis have made the Chinese relatively insusceptible to that disorder. Jewish people suffer less than other groups from alcoholism and tuberculosis, whereas they suffer particularly with diabetes and with a disease of the arteries known as thromboangiitis obliterans. The races of Africa and the South Sea Islands have been free for many years from such conditions as measles, but come down with serious epidemics from the disease when it is introduced among them For some unexplained reason scarlet fever is rare in the tropics; although cases have repeatedly gone into India, South America, and the Philippines, the result is only a local epidemic largely confined to newly arrived foreigners and with few cases developing among the local population. Several investigators have attempted to find out the reason for this immunity, and the most recent evidence indicates that this is due to some hereditary factor.

For instance, the Chinese are relatively free from scarlet fever as compared with the Japanese. Of 11,000 healthy Japanese tested, 37.3 percent were found positive to the Dick test, which was about the same percentage as reported by Zingher for New York City. On the other hand, only 19.4 of 3500 Chinese were found to be Dick positive. For a period of six years, the annual scarlet fever mortality among the Japanese was 361 per 100,000, as contrasted with 8 per 100,000 for the Chinese. —*M. F.*

HYBRID PLANT YIELDS PAPER AND OIL

BROTEX, a newly developed plant which threatens to replace hemp and to supply a suitable raw material for the manufacture of paper, is attracting considerable attention among British chemists The new plant is being grown in America, France, Germany, Kenya, and Canada, as well as in the British Isles, and its possibilities on a wide range of soils are interesting great numbers of scientists and agriculturists.

Experimental work which has been already carried out indicates that it is a sufficiently hardy plant to be grown successfully to yield a six months' fiber crop in many parts of England and in other countries. In its six months and later stages the plant produces fiber which can be used for sacking, cordage, ropes, and the products in which coarse hemp is usually employed. For paper-making it affords a very quick-growing material. Its seed can

The new home of the Mellon Institute as it will appear when finished

be used for cattle food in the form of oil cake having 15 percent edible oil.

The plant, which is a hybrid biennial, was produced after many years of experiment by Mr. Leonard Browning. No extravagant claims have been made for it, and the closest scientific research is still being carried on.—*A. E. B.*

NEW HOME TO BE BUILT FOR MELLON INSTITUTE

ONE of the most interesting places in the world to anyone interested in chemistry is the Mellon Institute in Pittsburgh, Pennsylvania, and one of the most interesting of all chemists is its director, Dr. E. R. Weidlein. The fascination of the great laboratory and its director are both due, in part, to the fact that their work keeps them about two jumps ahead of the innumerable applications of chemical engineering to industry, for the Mellon Institute is the scene of hundreds of scientific conquests that later find their way to the public in the form of improved products.

Manufacturers, groups of manufacturers in similar fields, and even trade associations establish fellowships at the Institute, making it possible for some highly trained chemist or engineer to concentrate on the particular technical problems that they are most anxious to have solved. At the present time there are 63 industrial fellowships, relating either directly or indirectly to almost any business that can be named. Now Director Weidlein announces that a monumental new home for Mellon Institute, illustrated herewith, will be started this fall.

When the present home of the institute was completed, in 1915, it was felt that the industrial fellowships procedure created by Robert Kennedy Duncan had passed from the experimental to the practical stage. The building, which was given to the Institute by Andrew W. and Richard B. Mellon, incorporated the best laboratory constructional features of that period. It was thought then that it would provide adequate space for growth for many years; but for practically 10 years the institute has had a waiting list of companies, often almost as long as the roster of companies whose problems were being investigated.

In addition to providing a greatly increased number of laboratories, the new building will give more commodious quarters for general departments. The present library contains 11,000 volumes; the new library is planned to accommodate 250,000 volumes. The present Department of Research in Pure Chemistry will be expanded and facilities for pure research in other branches of science will be provided. Much more elaborate chemical engineering laboratories are to be available in the new building, and also the fellowships in each specific field of industrial research are to be grouped in suites of rooms so that they can best make use of general apparatus adapted to their needs. Certain rooms will be equipped for specialized phases of experimental technique, such as electrochemistry, spectroscopy, low-temperature studies, radiations, high-pressure experimentation, and so forth. Other special features to be included are a large lecture hall, a dining hall, an industrial fellowship museum, and an underground garage. For the past five years, members of the institute's executive staff have been visiting laboratories in America and Europe to obtain information on new features in design and equipment.

The new laboratory structure will be of that type of classical Greek architecture known as Ionic. It is to be seven stories high, with monolithic columns along all four sides. The proportions will be approximately 300 by 100 feet. The main entrance, which is located on the third floor, is reached by steps extending along the entire front of the building. The laboratories are to face on interior courts. The design of the new building is to be such that additional laboratory suites can be constructed in the interior courts without marring the beauty of the general appearance and without interfering in any way with the original laboratory units.—*A. E. B.*

BASEBALL PITCHER'S ELBOW

WHEN a baseball pitcher winds up to pitch a ball, the arm and forearm should be held in extension and the throwing of the ball should be from the shoulder. Sometimes, during the wind-up, a pitcher will hold his arm slightly flexed; then as he prepares to throw the ball, by suddenly and forcibly contracting the muscles in the back of the arm and rotating the forearm and hand inward and downward to give speed to the ball, he extends his forearm rapidly. In the maneuver the head of the large bone of the forearm is brought backward suddenly and with great force against the large bone of the upper arm. As a result, a small piece of cartilage and bone from the head of the radius, the large bone of the forearm, may be chipped off, will remain about the joint, and be constantly irritating and troublesome with every movement.

The average velocity of a baseball after it leaves the pitcher's hand is about 90 feet a second. This will give some indication of the force involved in the production of this injury.

Dr. F. J. Kirby has reported two cases

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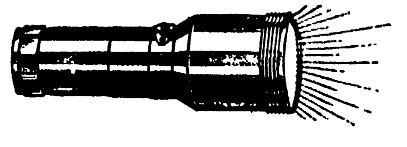

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of this character which came to his attention. In both, unfortunately, it was necessary to open the joint and to remove the small piece of bone in order to relieve the patient from constant difficulty in movement. Just as soon as the loose portion of the bone is removed and the operation wound heals, the patient is likely to recover fully.—*M. F.*

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GLASS bottles! How often they play their unobtrusive rôles in little dramas of modern life: The message floating at sea in a stoppered bottle; the tiny vial of serum rushed to save a life; the "pop" bottles at the ball park and the road stands; the daily milk bottles; the bottles that gleam in the chemists' laboratory, on the barber's shelf, in the drug store, the grocer's, the stationer's. It is hard to realize how completely our comfortable modern life would be disorganized if glass bottles were suddenly taken away from us.

Until comparatively recently, all glass bottles were blown by hand or, rather, by mouth. A "gob" of molten glass was balled around the end of a blow pipe, by a skilful glass blower, and the bottle blown by lung power into a mold which gave it the desired shape. The demand for more and cheaper bottles has spurred the glass technologist and the mechanical engineer to convert the age-old process to a highly refined machine operation, until today, we find at Alton, Illinois, a single factory which produces 300 tons of machine-blown bottles per day. The bottles produced here by the Owens-Illinois Glass Company include over 3200 different styles and sizes.

The molten glass fed to bottle machines must be exactly right in composition. Expert chemists control every step in its manufacture. In addition, finished bottles are inspected with instruments so delicate that the internal strains set up in the glass by holding a lighted match near the bottle can be readily discerned.

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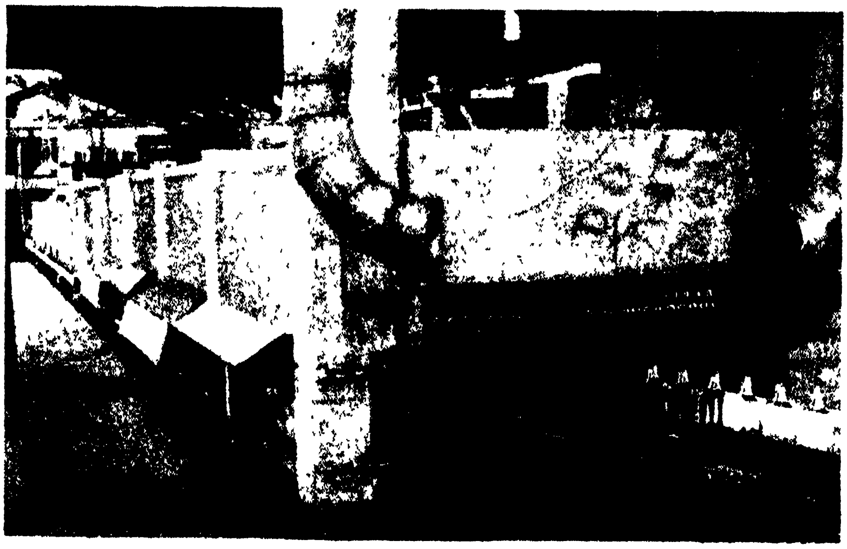
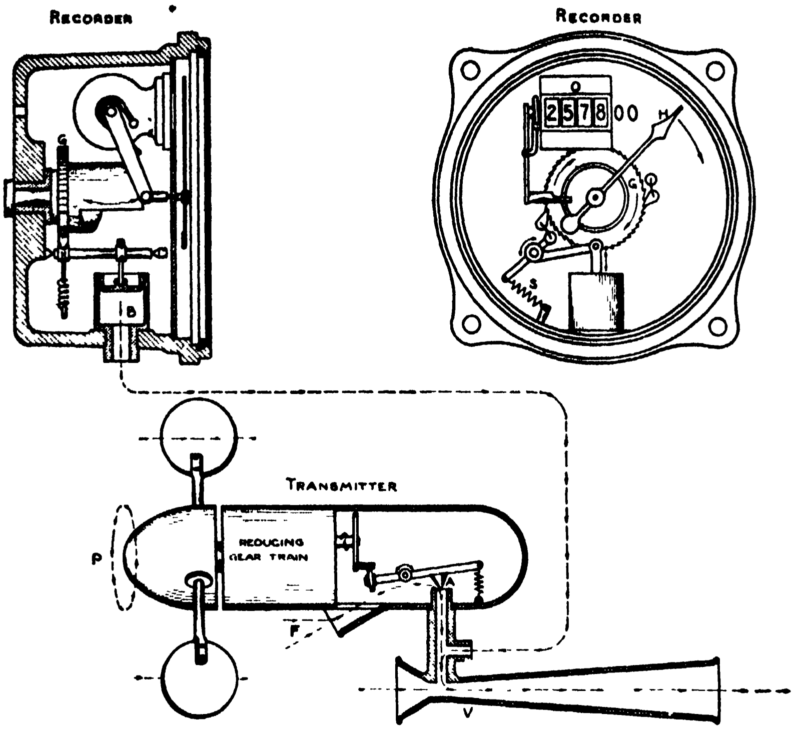
Right: **Largest bottle blowing machine in the world. It is a six-head, vacuum-feed type, standing 20 feet high and weighing 120 tons. The revolving pot of melted glass is just to the left of the attendant who is removing a five-gallon carboy from its mold. *Below:* The feed end of an electrically heated lehr, in which the bottles are annealed**

Photographs courtesy Owens-Illinois Glass Company





This new air log indicates airplane miles traveled

balance is used to determine slight losses in weight due to the solubility of glass, whole bottles being used in the experiments.

Machine-blown bottles furnish a striking and dramatic example of the mechanization of an ancient industry, made possible by the combined genius of scientists and engineers.—*A. E. B.*

USE OF ELECTRICITY DOUBLED

PER CAPITA use of electric power in the United States has more than doubled in the last ten years, according to statistics based on the 1930 census, says F. E. Bonner, executive secretary of the Federal Power Commission.

The figures show that for the entire country, the per capita use increased from 391 kilowatt-hours in 1920 to 800 kilowatt-hours in 1930.

THE AIR LOG

THERE is nothing more interesting on board ship than to lean over the taffrail and watch the log do its endless work of recording distance. The corresponding aircraft instrument, the air log, is less frequently employed. Its greatest value lies in long flights as an aid to navigation. It is also very useful for such records as fuel and oil consumption, mileage between overhauls, and other data of interest to the transport operator. The air log or air distance recorder as now built by the Pioneer Instrument Company, is an ingenious and interesting mechanism.

It consists of two parts—the transmitter and the recorder. In a biplane, the transmitter is mounted on one of the outer interplane struts, while on a monoplane it is mounted three feet or more ahead of the leading edge of the wing, so as to be free to some extent of the air-flow disturbance caused by the wing. The recorder is mounted on the pilot's instrument board. The two units are connected by a small copper tube. The basic principles of the recorder are clearly illustrated by the accompanying drawings.

The flow of air through the venturi tube V causes a suction at its throat or narrowest section, where the air must flow with its greatest velocity. This suction is carried through the copper tube to the piston B in the recorder, and pulls down the piston B against the action of the spring S.

The flow of air, as the plane moves forward, also rotates the flat disk propeller P, in the direction shown by the circle and arrows. The pitch of the propeller and the ratio of the gear train in the transmitter are such that the valve A is opened once every mile. This allows air to flow in at F and breaks the suction in the line. Once the suction is broken, the spring S pulls the piston B up to the top of its stroke, the position shown in the drawing. Simultaneously this causes the pawl to move the gear G one tooth, carrying the hand H on the recorder dial one unit forward. Valve A is then closed and the piston is once again sucked to the bottom of the cylinder ready to repeat the action at the end of the next mile.

The gear G has 100 teeth so that the hand makes one complete revolution for every 100 miles traveled. The gear also rotates a spiral cam causing the counter arm to move and indicate another hundred miles while the hand H continues on the next revolution. Total mileage flown is obtained by adding those shown by the counter and the hand. The mileage for a given trip is obtained by noting readings at the start and end of the trip.—*A. K.*

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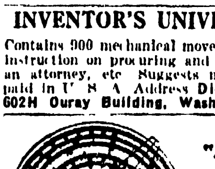

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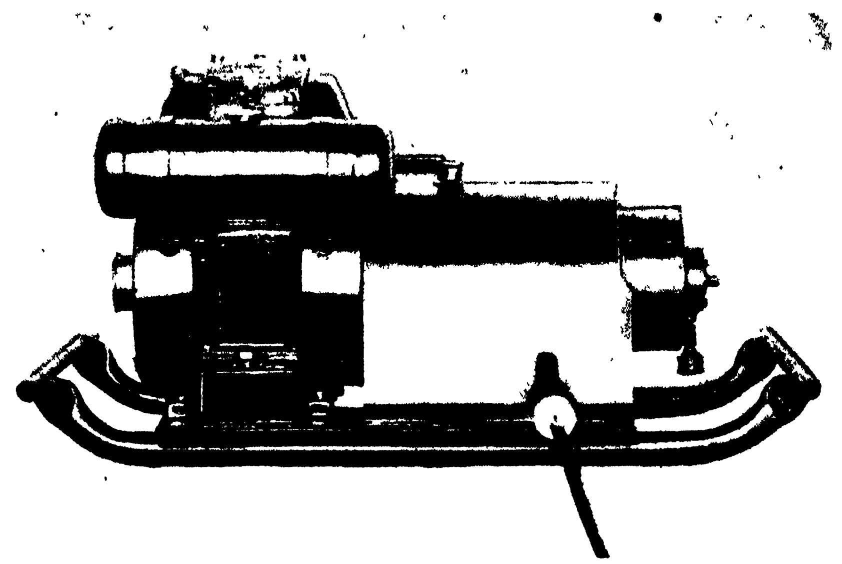

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SHORT REVIEWS OF BULLETINS AND PAPERS ON SCIENTIFIC AND ALLIED SUBJECTS, AND WHERE TO GET THEM

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, REPORT FOR 1929 is an important treatise on co-operative municipal-ownership power enterprises. Practically the whole province of Ontario is being supplied with Niagara Falls power at cost. There are excellent maps and a wealth of data. *Hydro-Electric Power Commission of Ontario, Toronto, Canada.—$2.00.*

◆

GEOLOGY AND WATER RESOURCES OF THE KAU DISTRICT, HAWAII (U. S. Geological Survey Water Supply Paper 616) is a misleading title, for the pamphlet is mainly descriptive of the geology of Mt. Kilauea where Dr. T. A. Jaggar maintains the United States Volcano Observatory. *Superintendent of Documents, Washington, D. C.—85 cents (money order).*

◆

BOOKLIST BOOKS 1929, A SELECTION, gives the most important list of the new books giving brief notes as to their value together with the number of pages and the prices. It is accompanied by a complete index. *American Library Association, Chicago.—65 cents.*

◆

AERONAUTICS TRADE DIRECTORY (Aeronautics Bulletin No. 3, Aeronautics Branch, U. S. Department of Commerce) is a most valuable booklet dealing with commodities and activities. It gives a complete list of manufacturers of airplanes, accessories, airport designers and constructors, engine manufacturers, hangar builders, and all the thousand and one items that go into this industry. It also gives a complete list of air-transport operators and aeronautical engineers. *U. S. Department of Commerce, Aeronautics Branch, Washington, D. C.—Gratis.*

◆

NATIONAL PHYSICAL LABORATORY REPORT FOR 1929 is a 300-page book giving a description of a year's research at Great Britain's "bureau of standards." It deals with heat, radiology, sound, optics, electricity, measurement, and general research. *His Majesty's Stationery Office, London, England.—Eleven Shillings.*

◆

THE ATMOSPHERE AND THE SUN (Smithsonian Miscellaneous Collection, Vol. 82, No. 7 by H. Helm Clayton) gives further scientific evidence of weather cycles, their causes and interpretation, with a particular view to long-range weather forecasting. *Smithsonian Institution, Washington, D. C. —25 cents.*

◆

EARLY PUEBLO RUINS IN SOUTHWESTERN COLORADO (Bulletin No. 96, Bureau of American Ethnology, Smithsonian Institution) by F. H. H. Roberts, Jr., is a 180 page account of archeological work done in 1928, with a brief history of early American cultures. Illustrated. *Superintendent of Documents, Washington, D. C.—75 cents.—Money order.*

AUTOMATIC ARC WELDING BY THE ELECTRONIC TORNADO PROCESS is a monograph on an accepted method for manufacturing pipe, tanks, boilers, and similar equipment when the production is sufficiently large to justify the cost of equipment. *The Lincoln Electric Company, Cleveland, Ohio.—Gratis.*

HINTS ON COYOTE AND WOLF TRAPPING (Leaflet No. 59, U. S. Department of Agriculture), *Superintendent of Documents, Washington, D. C.—5 cents, coin.*

MODERN METHODS IN REPAIR SHOPS is a large and beautifully illustrated monograph of 120 pages dealing with cranes, turn tables, car washers, and other devices useful in car shops, roundhouses and terminals. Free to interested parties. *Address Whiting Corporation, Harvey, Illinois.*

THE SURFACE WATERS OF MICHIGAN (Engineering Research Bulletin No. 16, Department of Engineering Research, University of Michigan) by Robert L. McNamee, outlines the hydrology and qualitative characteristics and purification of water for public use. Accompanied by an excellent series of maps *Department of Engineering Research, University of Michigan, Ann Arbor, Mich.—$1.50.*

THE INDUSTRIAL MUSEUM OF NEW YORK describes an exhibit of early astronomical and mathematical instruments. It also describes the David Eugene Smith collection and contains a monograph on the Astrolabe by Jekuthiel Ginsburg, A.M., and on (Sun) Dialing by J. Ernest G. Yalden. *Museum of the Peaceful Arts, Daily News Building, East 42nd St., New York City.—Gratis.*

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FORMATION AND PROPERTIES OF BOILER SCALE (Engineering Research Bulletin No. 15, Department of Engineering Research, University of Michigan) by Everett P. Partridge, is an elaborate discussion of the subject, accompanied by a full bibliography. *Department of Engineering Research, University of Michigan, Ann Arbor, Mich.—$1.00.*

SAFETY CODE FOR BRAKES AND BRAKE TESTING (Miscellaneous Publication No. 107, Bureau of Standards, Department of Commerce) gives valuable results which have been approved by the American Standards Association. *Superintendent of Documents, Washington, D. C.—5 cents, coin.*

SPICES AND CONDIMENTS (Leaflet No. 15, Field Museum of Natural History, Department of Botany) by James B. McNair, Assistant Curator of Economic Botany, is a valuable pamphlet fully illustrated and gives much out-of-the-way information. *Field Museum of Natural History, Chicago, Illinois.—25 cents.*

THE RUN OF THE TWENTIETH CENTURY, by Edward Hungerford, is one of the most illuminating publications on railroad service we have ever seen. It is accompanied by excellent diagrams and illustration. *New York Central Lines, 466 Lexington Avenue, New York City.— 50 cents.*

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING gives valuable information as to retirement and pensions. *Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York City.—Gratis.*

ARTIC, THE REFRIGERANT (Technical Paper No. 274) is a small treatise on the physical properties and performance data of Artic. Of value to anyone interested in refrigeration. *The Roessler & Hasslacher Chemical Co., Niagara Falls, N. Y.- Gratis.*

OUR POINT OF VIEW

(*Continued from page 319*)

of our Navy as a matter of course; actually it is the result of generations of systematic effort. The naval routine which trains American lads to become able seamen and capable petty officers, and develops midshipmen into captains and admirals is exacting. The naval exercises which gradually convert an aggregation of ships into a fighting fleet instantly responsive to the will of its commander, are arduous and unending.

The peace-time preparation of the fleet is carried on at sea or isolated anchorages, with none of the glamor of battle or the stimulus of war; it would become plain drudgery except for the animating spirit of the Navy that has been handed down from Paul Jones.

Pay the Navy personnel a visit on their annual day at home. Your interest will stimulate their future endeavors, and we believe you will come away a better American and more conscious of your obligations as a good citizen. The Navy selected Theodore Roosevelt's birthday for their annual day at home because that stalwart American devoted himself to increasing the efficiency of the fleet. Whether you are able to visit the Navy or not, remember his famous maxim, "Speak softly, but carry a big stick."

Great Britain Taken to Task by League of Nations THE Mandates Commission of the League of Nations is apparently taking its duties seriously, for it recently criticized the British Government severely for its failure to foresee and prevent the recent conflicts between Jews and Arabs in Palestine. Mr. Henderson, British Foreign Secretary, made a tart rejoinder and asserted that the Mandates Commission itself did not foresee these outbreaks although kept fully informed of

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conditions in Palestine. The exchange of notes will probably close the incident, for the League can scarcely be expected to take punitive steps against Great Britain.

Cynics have hitherto regarded "mandates" as a euphemism for "colonies" but the action of the League officials in the Palestine riots opens interesting future possibilities. And if the League dares to rebuke Great Britain, who with some justice prides herself on her ability as a colonial administrator, it will probably not hesitate to intervene in other instances.

The lot of present day Colonial Ministers is not easy, but if, in addition to answering the petitions of backward peoples clamoring for self-determination, they can be summoned to Geneva to give an account of their stewardship, additional troubles are in store for them.

There has been considerable discussion in England concerning the extent of her liability under the Covenant to use her Navy to enforce a decree of the League. Whose Navy *can* the League call upon to enforce a reform of a British mandate?

This incident, almost trivial in itself, illustrates the helplessness of a League of Nations; if the League authorities had the power to enforce their decisions, the world would be in the grip of a despotism just as real as the Roman Empire; without the power to enforce its decrees against a first rate state, the League can never be more than a common international scold.

Pilsudski and Poland PARLIAMENTARY government has received another setback in Europe. This time Poland chose to trust in its famous Marshal who turned back the Bolsheviks before Warsaw in 1920, rather than in a noisy, factious parliament.

There is nothing in the tragic history of a brave but politically unstable people to indicate that a parliamentary system will preserve Poland from internal disorders or external foes. Her first partition was made possible by factional jealousies and a constitution better adapted to protect Poles from their rulers than Poland from three land-hungry Emperors, possessed of well-equipped armies and endowed with power to use them at will. Poles, having to choose between an inefficient government under representative forms, and a Dictatorship which promises a strong but efficient government, have, like Italy, Jugoslavia, and Rumania, chosen the Dictator.

South American Revolutions THE exile of former President Irigoyen from Argentina is the climax and, we hope, the end of a series of revolutionary outbursts in South America.

Almost simultaneously the governments of Peru and Argentina were overthrown by successful revolts; the government of Bolivia had suffered a similar fate a few months earlier. Whatever may be the causes of these outbreaks, it is apparent that many South Americans still prefer to determine their elections with bullets.

We can not be indifferent to the customs of our Spanish-American neighbors. Peru, in particular, has been on peculiarly friendly relations with our country, and her recently deposed President Leguia was proud to proclaim his friendship for the United States. American mediation was instrumental in restoring one of Peru's lost provinces to her and in reducing the friction between Chile and Peru.

An American Naval Mission has been assisting the Peruvian Government to increase the efficiency of her Navy, and American capitalists have invested large sums to develop the mineral wealth of that small but richly endowed state.

As President Leguia became President by a military usurpation and retained power by military coercion, it will be easy for caustic critics to point the moral, but as during his long tenure Leguia gave his country domestic tranquillity and effected a settlement of the long-standing dispute with Chile, we hope his triumphant opponents will allow him an honorable exile and spare their new régime the needless stain of placing Peru's former President before a firing squad. As our State Department was willing to be considered his friend while he was in power, it should not hesitate to go to his assistance in his distress.

Argentina's deposed President, Irigoyen, prided himself on defying the United States, so in a negative way our relations with Argentina should improve by his deposition. Argentina has more trade with Great Britain than with the United States and many of her important industries are owned by English capitalists. There is a British-Argentine trade association actively engaged in fostering trade between the two countries. This association is preparing an exposition of British goods, to be held in Buenos Aires next year, and the British Government has shown its interest in the success of the exposition by agreeing to send the Prince of Wales as its representative.

England buys much of Argentina's meat and wool and sells manufactured goods to that country. One of the reasons urged against a British Empire preferential tariff is the large Argentine trade that would be adversely affected if Argentina were left outside the British tariff wall.

Mexico

AGAINST the revolutions in South America should be placed the orderly opening by President Rubio of the 34th Mexican Congress. He predicted that Mexico had definitely entered upon an era of peaceful reconstruction. Americans, although not so optimistic as President Rubio, will wish their southern neighbor well. No other country has so large an interest in Mexico's stability and prosperity; and our long forbearance should, by now, have convinced Mexico's rulers that we have no sinister designs on her territory and only wish to see her peaceful and prosperous.

Both Cuba and Panama have shown restlessness under their present rulers, and but for their treaty relations with us, would, undoubtedly, have gone the way of Peru and Argentina. The editor of a paper in Panama regrets that their relations with the United States prevent Panamanians from indulging in revolutions, that are open to all other Spanish-American countries; he extols the freedom of action open to a dictator to achieve reforms unhampered by a laggard legislature; and has nothing but pity for an executive who is under the mortifying necessity of soliciting the ballots of his fellow-countrymen. When we feel superior about our electoral customs, we should remember that many other peoples have little faith in ballots.

FOOTBALL

(*Continued from page 372*)

one-sided to give the new plan a fair trial.

As to the first of the foregoing points brought out in favor of the system, the losing team never had the ball in its possession during the last 20 plays. Concerning the second point, there can be no doubt of the value of the plan—the stop-watch is entirely unnecessary, and all that is required of the official timer is that he be able to count up to 40.

From the spectator-interest standpoint, this test game seemed to prove there was *less* interest shown, which, of course, may have been due to the uneven score. However, using the period-by-play system, in place of the interval elapsed, there is more of a tendency on the part of the players to waste time between plays. When this occurs the number of plays per minute is decreased, and spectator interest tends to wane. In the Brown-Boston University game, the number of plays in both the third and fourth quarters was reduced from 40 to 35 because of approaching darkness.

The data for the eight games studied indicates that the average number of plays per quarter consistently increased slightly in each succeeding quarter, which is as might have been anticipated. As soon as the losing side sees the end of the game is coming nearer, they invariably speed up their game; they lose little time in giving signals and in shifting formations. Thus the average number of plays in the first quarter was 40.3, 41.3 for the second, 41.5 for the third, and 42.9 in the last. The actual time the ball was in motion in the first quarter averaged 2 minutes 55 seconds, and 3 minutes 19 seconds in the last.

A complete chart of the 1929 Army-Notre Dame game at the Yankee Stadium in New York City last November appears on page 371. This chart shows in detail the plays made by each team as the game progressed The legend, giving the symbols used, is located in the upper left hand corner.

In this very interesting and exciting game not a single forward pass was completed. However, Notre Dame intercepted three of the Army's passes, one of which ended in Elder's famous run and touchdown—the kind of a run that sinks and stays in the mind of the average football fan for years.

Applying Coach Glenn Warner's system of scoring—which awards a point for every first down made and eliminates the try-for-point after a touchdown—the score in this game would have been 12 to 5 in favor of Notre Dame. The Southbenders made six first downs and the West Pointers five. The difference in scores under the Warner method would have been seven, which was the same margin by which Notre Dame won using the orthodox method of scoring.

The two vertical black bars at the right-hand side of the chart represent the time the ball was actually in motion, and the time elapsed from the initial kick-off to the end of the game. The bars emphasize graphically the large difference between the playing time and the elapsed time; it will be observed that the latter is about 10 times the former, which visually explains the statement that you pay about twenty-five dollars per hour to watch football.

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COMMERCIAL PROPERTY NEWS

Conducted by **SYLVESTER J. LIDDY**

New York Bar

BETTER MAILING CONTAINER SOUGHT

SAFER and lighter packing for parcel-post shipments in the international mails would help to increase American export trade in liquid preparations, according to a statement just made public by the Department of Commerce, prepared by Thomas E. Lyon, Assistant Chief of the Department's Transportation Division.

A method of packaging by a manufacturer of pharmaceutical goods is described in the statement, which follows in full text:

During the year 1929 the United States exported medicinal and pharmaceutical preparations to the total value of 21,282,000 dollars. More than one-half of this sum, or 11,655,000 dollars, composed medicinal preparations for internal use, which usually are shipped in bottles and distributed in small units. This last figure could be considerably augmented by other liquid preparations, such as hair tonics, toilet preparations, and so forth, which are usually sold in similar packages. While a considerable part of this trade is shipped by freight, American exporters have felt that it could be increased if parcel-post shipping conditions were improved. Heretofore it has been necessary in making parcel-post shipments to fill packages with sufficient absorbent material to take up any leakage caused by breakage; the absorbent material, as a rule, exceeded the actual weight of the commodity shipped, and thereby increased parcel-post charges.

A well known manufacturer of pharmaceutical goods recently carried on a considerable series of experiments with a view to improving his parcel-post package and has succeeded in developing an economical package which meets the requirements of the Post Office Department. He has furnished the Bureau of Foreign and Domestic Commerce with a description of this package, as follows:

At first a number of experiments were made with various forms of absorbent material packed around the bottles, the outer container being either waterproof or lined with a waterproof material. None of these produced a satisfactory package, however, and finally this idea was discarded and the work directed toward finding some sort of container or case which would adequately protect each bottle.

Obviously a case was required which would be light, very strong, waterproof, and not too expensive, and inside of this case must be placed a sufficient amount of some absorbent material to take care of the loss of the entire contents of the bottle, if necessary.

The form of protection finally adopted for each bottle was a five-ply fiber-board round mailing case, paraffin-sprayed both inside and out, and with a metal screw cap. The fiber-board of which it is made tests 295 pounds on a standard Mullen tester.

A feature of this case is the fact that the threads which engage the screw cap when the case is closed are formed in the fiber board itself during the process of manufacture, instead of being made of metal and fastened to the top of the tube. Such a method of construction insures an extremely tight closure when the cap is screwed down, for then the top of the fiber tube is pressed very closely against the inside of the metal cap, and, being of softer material than the cap, gives just enough to produce the same effect as if a washer were used. This case was found to be absolutely water-tight under tests conducted over a considerable period of time and with the package in various positions.

The absorbent materials ordinarily used, such as bran, sawdust, and so forth, were all unsatisfactory, and the material finally adopted was crêpe wadding. In using this material it was found that no corrugated liners, pads, or disks were necessary.

In assembling the packages for shipment, sheets of crêpe wadding were first procured of such a size that they were about six inches longer than the bottles, and wide enough to produce an overlap of at least two inches and cause the bottles to fit snugly in the cases. Each bottle was then placed in the middle of a sheet, the material was rolled around it, the two ends were tucked in, the wrapped package slid into the case, and the metal top screwed down tightly. The 12 individual cases were then placed in the corrugated box, and the box sealed with sealing glue under pressure in the customary manner.

The complete box, holding one dozen eight-ounce bottles, weighed 17 pounds 15 ounces. The standard export case, containing six dozen of these same bottles, weighs 120 pounds, or 20 pounds per dozen. In spite of the additional protection given the individual bottles by this method of packing, the total weight per dozen has been reduced over 10 percent.

"U. S." ENDORSEMENT IS FALSELY CLAIMED

FALSELY asserting that their respective products had received endorsement of the United States Government, a beverage manufacturer and a correspondence school signed stipulations with the Federal Trade Commission agreeing to cease the practice. The beverage company also misrepresented the qualities of its product.

Details of stipulations are as follows:

(1.) Statements which do not truthfully describe the properties and powers or the curative and therapeutic effects to be derived from use of a certain beverage will no longer be inserted in the advertisements of a corporation manufacturing such beverages.

The company will also cease representations which imply that the beverage has been approved by the United States Government, and will discontinue assertions to the effect that the preparation is used in government and other hospitals and in sanitariums and is prescribed by physicians and dieticians, unless and until such averments are substantiated by fact.

(2.) Representations tending to confuse the public into the belief that its home study courses of instruction in aviation have the approval of, or are rated, inspected, or graded by the United States Government or have the official endorsement of authorities in aviation, when such is not the fact, will be discontinued by a corporation conducting a correspondence school.

GOLF TAX NOT APPLICABLE TO MINIATURE COURSES

SO-CALLED "miniature golf" has no intrinsic relationship, though there are points of similarity, to the recognized game of golf, according to a ruling of the Supreme Court of the District of Columbia.

A license for the operation of the miniature game, therefore, Chief Justice Wheat of the court ruled, may not be exacted under the provision of the District of Columbia licensing act providing for the payment of a license fee of $5 a day for a golf course or kindred game.

The court directed the issuance of a mandamus against Wade H. Coombs, superintendent of licenses, requiring him to grant a license to the operator of a "miniature golf course" under another provision of the licensing act providing for the fee of $100 annually.

The name, Chief Justice Wheat stated, had nothing to do with making the game kindred to golf, pointing out that sometimes a game of dice is known as "African golf."

TRADEMARKS IN FOREIGN LANDS

THE influence of the common-law theory of property rights in trademarks, writes James L. Brown, Chief of the Patent and Trademark Section, Division of Commercial Laws, Department of Commerce, in a recent issue of the *United States Daily*, is noticeable to some extent in many countries where the common law does not generally prevail.

A recent case in one of the Slavonic countries called to mind the recognition given to certain industrial property rights regarded as inherent by the common law and not so recognized in countries where the civil law forms the basis for jurisprudence. A similar instance in Panama brought to light the fact that the theory of exclusive property right in the first user of a trademark limited to an extent the generally understood meaning of the term "first user." With the expansion of international trade, many of the countries not having the common law system of jurisprudence have given recognition to the intangible property right in trademarks by virtue of prior use.

The American exporter is often confused, if not misled, by the expression of the term "prior user" when considering the rights in trademarks, labels, or other means by which he identifies his products shipped abroad. Considering this expression from a general viewpoint, it would seem that he who first adopts and uses a mark in connection with his goods would generally be considered as a prior user and within the expression of the laws of most foreign countries that a prior user is entitled to the registration and exclusive use of a trademark.

It must be understood that provisions in foreign trademark laws protecting the rights of a prior user are intended to cover only prior use within that particular country and, although one has adopted and is the prior user of a trademark in his home country, the property right acquired thereby is not extensive to other countries where the rule of prior user prevails. It is often because of this misunderstanding regarding such provisions in foreign laws that foreign dealers are able to acquire the right to register a trademark and thereby its exclusive use.

In this connection, however, the laws are not uniform and the right acquired by prior user in many of these countries is recognized only for a limited period of time; that is, the prior user may have a registration by another or subsequent user set aside within a given period of time after the registration has been effected. This period of time in which to oppose a registration by a subsequent user varies from 30 days to three years.

While the American exporter should give particular attention to the protection of his marks in the countries where the first applicant of a trademark is entitled to its exclusive use, he should not be unmindful of the necessity of giving earnest consideration to the question of the protection of his mark in the countries where the prior user will prevail. In practically all countries of that group in which the prior user of a mark is entitled to the registration and the exclusive use thereof, it is also advisable to obtain registration since this is prima facie evidence of ownership and may be required in any action for infringement that may be brought later.

Despite the attention that has been given by the American exporter to the intangible right in industrial property in foreign countries, whether it be in the nature of obtaining patents for inventions and useful discoveries; copyright and literary and artistic works; or registration of trademarks, trade names, labels, and containers; there is a steady increase in the tendency abroad to profit by the good will established through advertising and other media by simulating American products and their means of identification.

PUBLICATION TITLES DENIED REGISTRATION

FIRST Assistant Commissioner Kinnan has held that the Fawcett Publications, Inc., of Robbinsdale, Minnesota, is not entitled to register either the words *Modern Mechanics* or the words *Modern Mechanics and Inventions* as trademarks for magazines in view of the prior use by Popular Mechanics Company, of Chicago, Illinois, of the term *Popular Mechanics* as a trademark for a magazine.

The ground of the decision is that the goods are the same and the marks as applied thereto are confusingly similar.

In the decision, after stating that the opposer had used its mark for over a quarter of a century prior to the adoption of the mark by the applicant, had established a large circulation and spent considerable sums of money in advertising, and that if there is a doubt it must be resolved against the newcomer, the First Assistant Commissioner said.

"It is believed this case is controlled by the decision in the case of New Metropolitan Fiction, Inc. v. Dell Pub. Co. 364 O. G. 778, 57 App. D. C. 244. In this case application was made for the registration of the words *Modern Marriage* as a title for a monthly magazine. The opposer proved priority of adoption and use of its registered marks *Marriage* and *Marriage Stories*, (quoting from the decision). The court further referred to the holdings in the cases of Vogue Co. v. Brentano's, 261 Fed. 420, in which the trademark *Vogue* as the name of a magazine was held to be infringed by the use of *La Vogue Parisienne* as the name of another publication, and Art Metal Const. Co. v. Textile Pub. Co., 54 App. D. C. 75, in which the name *The Office Economist* was held confusingly similar to the name *Dry Goods Economist* when used upon similar publications.

"It is clear enough, and the testimony supports the conclusion, that confusion will result from the use of these two names upon the respective magazines."

INVENTOR NEED NOT UNDERSTAND REACTION

IN a recent appeal from the decision of the examiner finally rejecting claims 1 to 5, inclusive, and claims 8, 9, and 10 on a patent recently issued, Shannon Smith, patentee, emerged victorious. Claims 1 and 3 are illustrative of the subject-matter on appeal

1. A composition of matter for cutting back bituminous material of the character described, said composition including a mixture of quicklime and Glauber's salt in the proportions of substantially nine parts of quicklime to one part of Glauber's salt.

3. A composition of matter for cutting back bituminous material of the character described, said composition comprising light oil and a mixture of quicklime and Glauber's salt in the proportions of substantially nine parts of quicklime to one part of Glauber's salt.

The references relied upon by the examiner are:

Amies (Br), 9929, of 1909; Erwin, 1409088, Mar. 7, 1922; Amies, 951471, Mar. 8, 1910.

Each of the appealed claims is comparatively specific, drawn to a composition of matter for cutting back bituminous material and including a mixture of quicklime and Glauber's salt. Some of the claims include additionally specific proportions of these ingredients and a light oil.

This specific composition of matter for the stated purpose is not disclosed in either of the cited patents. The nearest approach to a disclosure of such composition is found in the Erwin patent, but this patent is indefinite as to the character of the lime employed and fails to disclose the use of Glauber's salt.

The contention of the examiner to the effect that sodium sulfate, broadly considered, referred to in the references, is the same as Glauber's salt, has no basis in fact, Glauber's salt being a specific form of sodium sulfate.

As the applicant's composition is specifically new and as it possesses advantages in the particular use to which it is employed over the compositions disclosed by the references, no reason is apparent why the appealed claim should not be allowed.

With reference to the examiner's contention in his supplemental statement to the effect that the explanation contained in the affidavit of James F. Carle that there is a reaction between the quicklime and Glauber's salt, wherein the quicklime takes up the water of crystalization of the said salt, thereby absorbing a portion of the heat evolved by the slaking of the quicklime to such a degree that the light oils of the bituminous materials are not evaporated, is inconsistent with the specification and claims, which make no mention of such a reaction, it may be stated that such contention is without basis in fact. The claims on appeal are wholly consistent with the original disclosures and the original claims They are perfectly definite as to the character of the composition and its use upon the bituminous material. They are addressed to one skilled in the art and to practice the invention it is only necessary to employ the described composition in the described manner. An inventor is not required to understand the chemical reactions which take place in a composition, a disclosure of the composition and how it is employed constituting a full compliance with the law (section 4888 R. S.).

The decision of the examiner is reversed.

PAPER TRADE MEN QUIT UNFAIR COMPETITIVE METHODS

WITHDRAWALS of unfair competitive practices in the paper trade are reported by the Federal Trade Commission in two stipulation proceedings, one with a publisher of a monthly magazine devoted to the interests of the paper and pulp trade, the other with a company dealing in paper products.

Details of these particular cases are as follows

(1.) The publisher of a monthly periodical devoted to the interests of the paper and pulp trade will no longer republish or reproduce printed material published by his competitors when such purported reproduction is not complete, unless he prints along with such information notice to the effect that it is not complete.

(2.) Use of the word "mills" in advertising will be discontinued by a corporation selling and distributing paper products so as not to deceive buyers into the belief that the company owns or operates a mill in which the products sold by it are made, according to a stipulation agreement between the company and the Federal Trade Commission.

BOOKS SELECTED BY THE EDITORS

THE PERSON OF EVOLUTION—*By W. D. Lightall, LL.D.*

THIS is not a book on evolution as the word generally is used, but on philosophy. Science does not attempt to go behind appearances, while philosophy does. Within the past five years a growing group of the world's ablest, most profound men of science—Compton, Millikan, Russell, Wheeler, Whitehead, Eddington, Smuts, Haldane, Needham, and others in high circles—have invaded the domain of philosophy and, though they differ somewhat in their interpretation, their thought centers around what might be called a scientific "religion" of "emergent evolution." Of this new trend, which rationalizes the more common emotional, revealed type of religion, the book under review is a splendid summary of 216 pages.

The central idea is, that the whole Universe, whether "inert" or living, is evolving toward a definite goal, imbued with a reasoning, directive, purposive power or "Outer Consciousness," the "Person of Evolution." Of this superpersonality or composite reasoning being, all lesser individuals, including ourselves, are extensions. This in turn explains our inherited memories, instinctive fears, the so-called instincts of animals; our conscience and altruism; and immortality.

This whole new trend toward a spiritual interpretation of the world is opposed to the materialistic interpretation by which all events are simply the mathematical resultants of causes, without intervention of purpose; likewise it favors the vitalistic concepts of life which, however, seem to most men of science to border on mysticism. The author concludes that "religion and science are not in two compartments, as nearly all the leading theologians and nearly all the leading present men of science say they are."—$2.20 postpaid—*A. G. I.*

WE have been asked a number of times what the italicized initials mean that appear at the end of some of the book reviews. These are the initials of the reviewing editor.

***A. G. I.*—Albert G. Ingalls, Science**

***A. A. H.*—Albert A. Hopkins, Fine Arts**

***F. D. McH.*—Fred D. McHugh, Engineering**

***A. P. P.*—A. P. Peck, Radio, Television**

Where no initials appear the review is by L. S. Treadwell who has responsibility for this department and to whom should be directed any questions that you may care to ask concerning books or other subjects upon which you desire information. Our staff cannot always answer your queries (no small collection of men can possibly envision all knowledge) but it is seldom that we are unable to give some tangible reference.

WAVE MECHANICS—*By A. Sommerfeld, Prof. Physics, Munich*

THE rapid succession of published papers on the theory of the atom and on atomic phenomena generally makes it almost impossible for the ordinary physicist to realise the present position of his subject. Professor Sommerfeld has brilliantly performed the task of surveying all the recent important developments and has also treated a number of the older facts in a new way. The achievements of de Broglie, Heisenberg, Schrödinger and Dirac are clearly set out, and it is shown how the weaknesses inherent in the Bohr atom have in many cases been successfully overcome. The work is almost wholly written in higher mathematics.—$6.40 postpaid—*A. G. I.*

INDUSTRIAL REFRIGERATION, COLD STORAGE AND ICE-MAKING—*By A. J. Wallis-Tayler*

THIS seventh edition of an English work covers the entire subject most thoroughly in 162 pages, with a final chapter on small commercial and household refrigerating plants. It is a history of refrigeration as well as a text book of current practice and is a reference of international comprehensiveness.—$10.25 postpaid.

INDUCTION COILS—*By F. E. Austin*

THERE has been real need for a work on this subject because of its application to automobiles, telephony, wireless telegraphy, and X-ray diagnosis. This little volume so trenchantly and completely presented will be welcomed by those who have been unable to uncover this information in other sources. Specific instructions for building large and small coils to operate wireless outfits are also included. A most complete and satisfactory presentation.—$1.15 postpaid.

ABC OF GLIDING AND SAILFLYING—*By Victor W. Pagé*

GERMAN experience extending over a number of years has been largely drawn upon to furnish the material for this simple and practical treatise, prepared with special reference to the needs of young beginners in aviation. It gives diagrams of many of the important planes with details of materials used and the general construction. Formation of gliding clubs and details of training are adequately covered.—$2.15 postpaid.

THE CONQUEST OF LIFE—*By Theodore Koppanyi*

THE subject of this 256-page book is biology—anatomy, embryology, evolution, heredity, physiology—but it is not at all like a textbook, rather is it designed for pleasant, though serious reading. The author has chosen some of the "pleasant spots" of this big broad science and dwelt on them at considerable length and with more than considerable interest. The chapter on the endocrine glands and the one entitled "Masculine and Feminine" are especially notable.—$2.15 postpaid—*A. G. I.*

THE GREEN LEAF—*By D. T. MacDougal, Carnegie Institution*

THE "major activities of plants in sunlight" (sub-title of the book) have been kept too largely in the dark and many of us therefore think of plants as dull inanimate things. But Dr. MacDougal's new book—which, by the way, concerns mainly what goes on in the insides of plants, an aspect we seldom hear of—shows that they are almost as human and interesting as monkeys. The "visit to the green-leaf mills," in which we actually crawl into a manhole in a 100,000-times magnified leaf and climb around the interior, reveals what a lively chemical laboratory a leaf is. Other inquisitions on trees bring to light whole factories full of hustle and bustle and machinery, of which most of us are not aware, perhaps because, unlike animals, trees do not roar or bark. The author's life work has been devoted to research on these silent manufacturing centers and the book represents information at first hand from a noted man of

FROM RECENT PUBLICATIONS

science. In addition it is full of interest; for example, such things as that a healthy tree manufactures lumber at the rate of one broomstick a day.—$2.15 postpaid.—*A. G. I.*

THE MOUND BUILDERS—*By H. C. Shetrone, Dir. Ohio State Arch. and Hist. Soc.*

FOR a long period of years there has been no up-to-date, all-around treatise on the mound builders, but at last one has been published and it is a rarely good one. Dr. Shetrone, than whom no scientific authority is better fitted to write on this subject, has made a splendid round-up of the whole field. The book has two parts, 165 pages being devoted to the various cultural phases of the mound builders, while in the remainder of the 500 pages the known mounds, of which there are myriads, are taken up systematically region by region, state by state, from Gulf to Canada and Atlantic to the West, and dealt with in detail. Finally, the intriguing question "Who were the mounders?" is discussed scientifically. The style is wholly non-technical and replete with interest, while the handsome, rather large volume (6½ by 9½) is printed in good type on fine, heavy, filled paper, has 299 illustrations, and is attractively bound. This book doubtless will be *the* standard work both for reading and reference during many years to come.—$7.70 postpaid.—*A. G. I.*

THE SECRETARY'S GUIDE—*By C. O. Sylvester Mawson*

NO more useful little book has come to our desk in a long time. It covers thoroughly, in most condensed form, the correct modern usage for spelling, compounding, capitalization, punctuation, abbreviations, figures and numerals, sizes and styles of type, use of italic, spacing, proofreading, correspondence, and diction. It goes at once on our reference shelf and we predict it will be used frequently as its general utility is much greater than the name indicates.—$2.15 postpaid.

THE ENLARGEMENT OF PERSONALITY—*By J. H. Denison*

THIS is not a psychological treatise in the sense we generally understand that term, but a common sense discussion of the facts of consciousness which are a matter of common experience and of historic record and a suggested interpretation of them. If a man is given a new and different idea of what he is, that idea in many instances will so recondition his reactions that his behavior and character will be materially altered. The process and proof are carefully developed by the author.—$3.20 postpaid.

THE REAL WAR 1914 TO 1918—*By Captain B. H. Liddell Hart*

EXPERT diagnosis is usually so detailed and laboriously compiled that one reads with a considerable sense of compulsion. Here the author gives us a quick resume of the official facts and their significance. "The Origins of the War"—Chapter I—is the clearest, most comprehensive review that we recall reading. The stories of the various major engagements run smoothly and vividly. Facts are discussed and sentimental reputations are no bar to criticism and a fearless endeavor properly to evaluate the tactical value of leadership. We believe this work will rank high in the more analytical literature of the late war. 495 pages and a most complete index.—$4.20 postpaid.

NEW WAYS TO MAKE MONEY—*By Roger W. Babson*

"TO help young people in selecting a vocation which has a great future"—to quote the author. Incidentally we might add that the adult might well give it careful reading for the keen insight into industry and business which with swift, decisive, almost curt sentences outlines the various opportunities in a wide variety of lines of effort. There have been other good books on "Choosing a Profession" and so on, but none to our mind quite so inclusive yet almost statistical in its briefness, as is this text.—$2.65 postpaid.

ROUGH AND TUMBLE ON OLD CLIPPER SHIPS—*By Captain Bob Ramsay*

THIS rousing, hearty story by an old shell-back is vivid with life, character study and tales of feats of the fast clipper ship in strange seas and foreign ports. It relates adventures of shark fighting, mutiny, and stern discipline, material ranging from deep sea diving to navigation on the Great Lakes. Primarily, however, the real rough adventure which attended the heyday of navigation is the keynote. A real tale by a real sailor.—$3.20 postpaid.

THE WILD GRIZZLIES OF ALASKA—*By John M. Holzworth*

THREE years collecting material for the U. S. Biological Survey enabled the author to study the grizzly and big brown bear as well as mountain sheep and caribou. An experienced scientific observer with all the enthusiasm of the tenderfoot writes in conversational style of most adventurous experiences, many of which give an entirely different idea of these wild beasts from that generally understood by most of us. 95 beautiful photogravure illustrations.—$5.20 postpaid.

UNVEILED—*By Selma Ekrem*

AN accomplished Turkish girl of distinguished ancestry gives an intimate picture of the daily life of an official family during the period of the struggle for freedom from the tyranny of the times and of war. All the hopelessness of oppression, the hopefulness of brighter days ahead, the swaying back and forth of the fortunes of war and despotism are depicted with an extremely facile pen, to make a story that is truly unique in subject matter and viewpoint.—$3.20 postpaid.

RIDERS OF THE PLAGUES—*By James A. Tobey*

AN accurate description of some of the worst plagues that have afflicted the world and the way man found out about them and conquered. Also an appreciation of many of the valiant men and women who have been responsible for some of the most dramatic events in human history a story abounding in pathos and heroism. The author is an expert in public health, so he brings to the subject sound knowledge and fervent enthusiasm.—$3.65 postpaid.

WILD FLOWERS—*By James E. Jones*

A UNIQUE and happy arrangement of the familiar wild flowers and weeds grouped alphabetically by color orders. One need know nothing about botany speedily to locate a specimen, when will be found the colloquial name, the botanical name, and a short note covering occurrence and range with often an item of special interest.—$1.65 postpaid.

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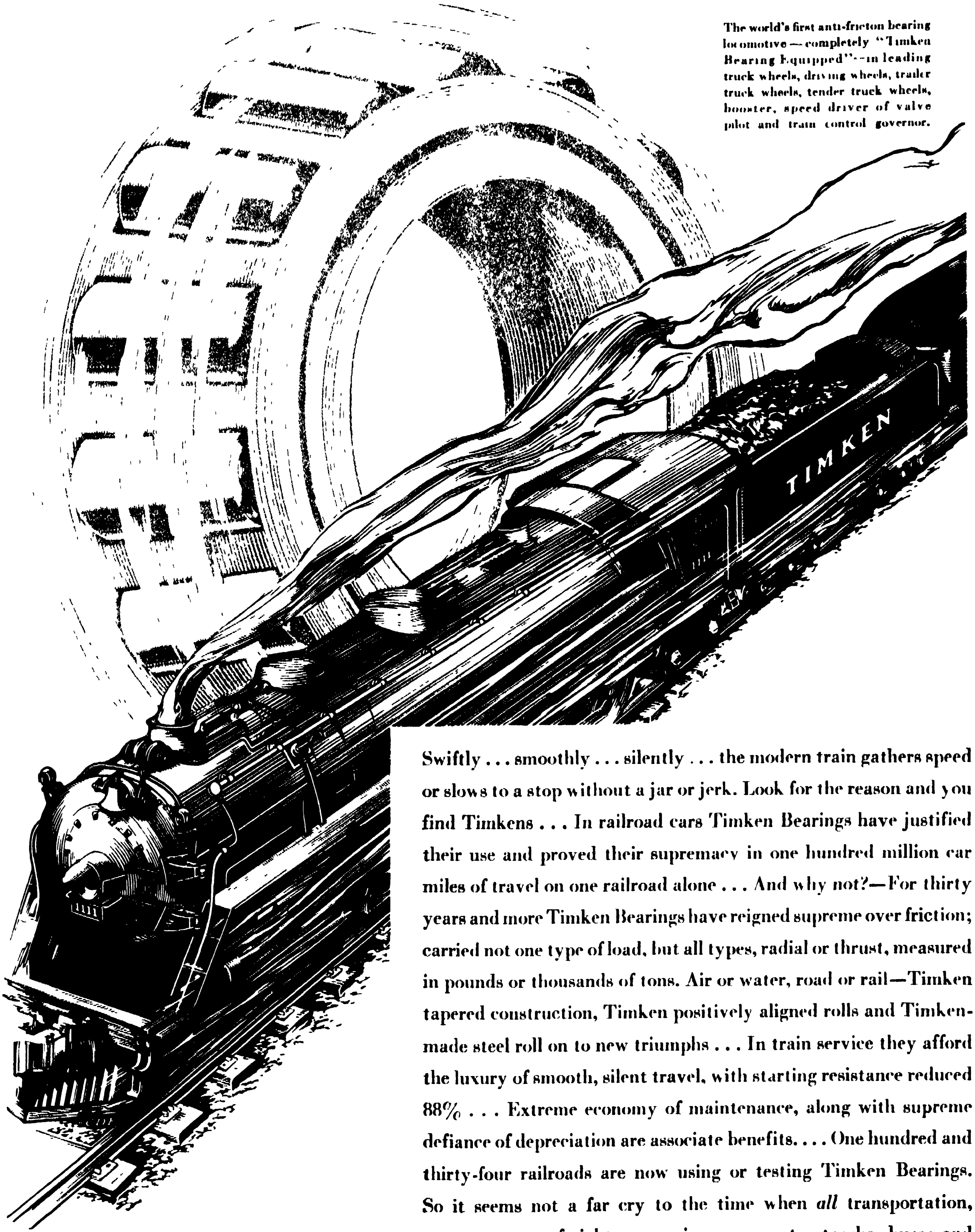

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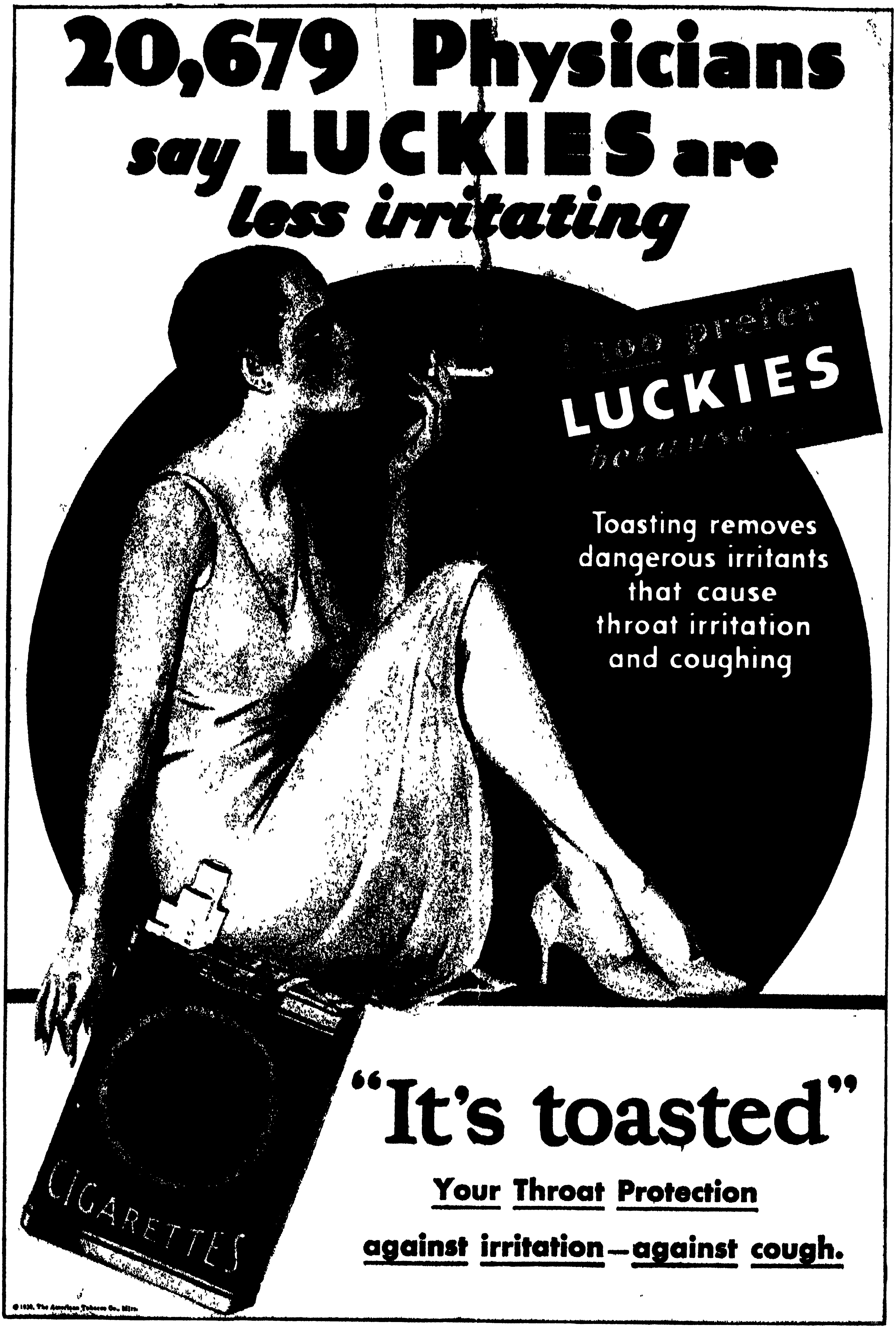

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X Rays Probe the Atom • • More About Pluto

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December • 1930

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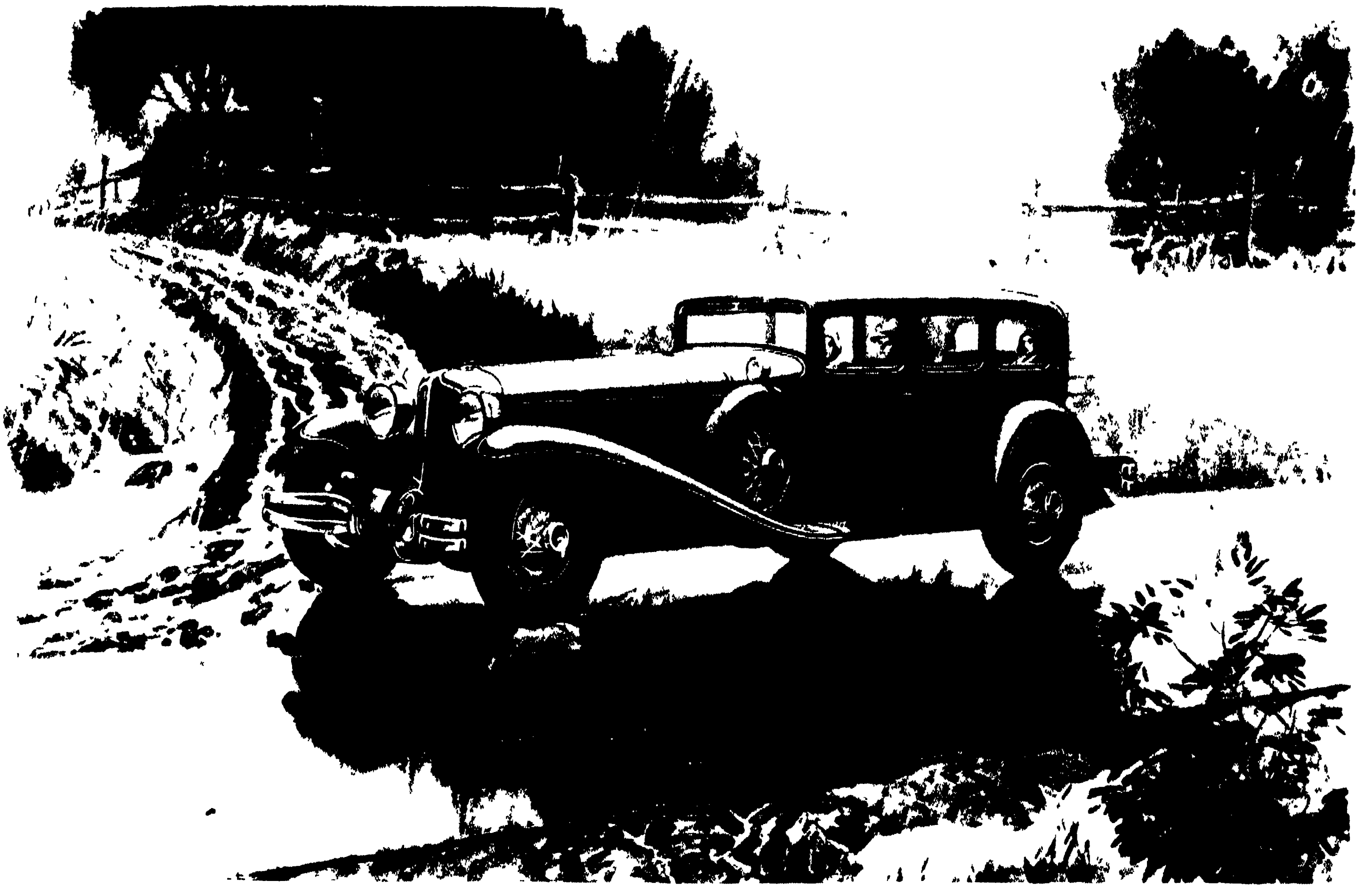
PROF. R. W. WOOD DEMONSTRATING THE NEW "RAMAN EFFECT" IN PHYSICS



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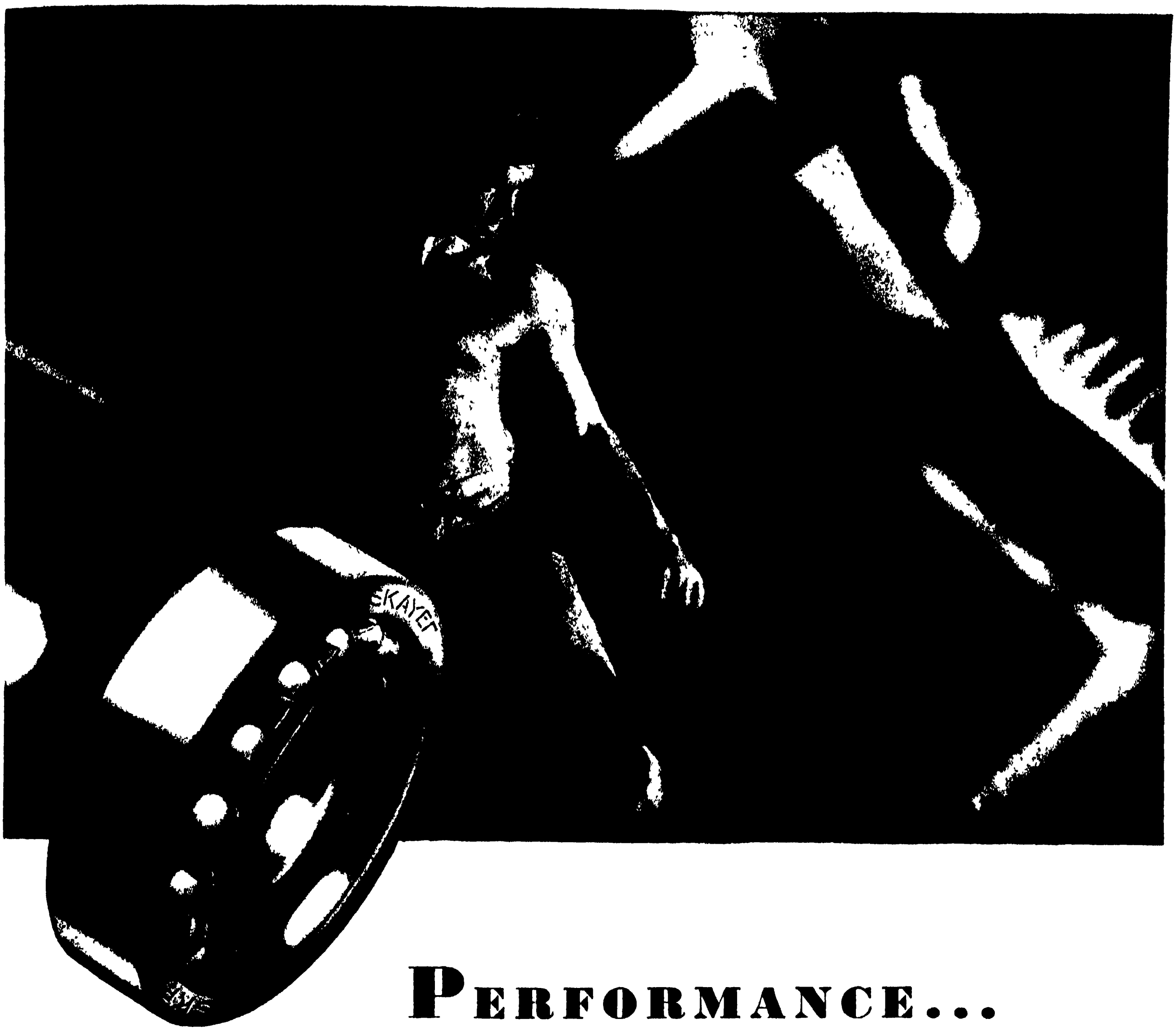

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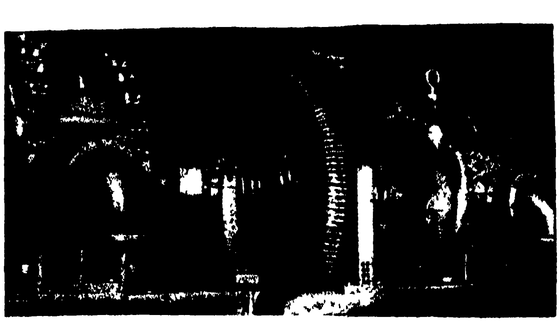

Performance was the thing that inspired the choice of SKF Bearings for these giant pumps, made by the Nash Engineering Company of South Norwalk, Conn. Photograph illustrates the largest vacuum pump installation in the world.

2587

THE • HIGHEST • PRICED BEARING • IN • THE • WORLD

SCIENTIFIC AMERICAN, December 1930, Vol 143, No. 6 entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879, additional entry at Greenwich, Conn Published monthly by Scientific American Publishing Company, 24 West 40th Street, New York City Copyrighted 1930 by Scientific American Publishing Company, Great Britain rights reserved. Subscription price $4.00 per year. Foreign $5 00

ACROSS THE EDITOR'S DESK

THE welcome that was accorded our November issue, in its new format, was most gratifying to us, confirming as it did our editorial policy and opinion. After the rush that always attends going to press, we sat back in our chair and looked over the advance copy with critical eye. Frankly, we were pleased with the result, and now many of you have voiced the same thought. We thank you, and want you to feel that we always welcome the opinions of our readers.

In this, the last issue of 1930, we present a selection of articles intended to appeal to the most diversified tastes. Pure science, never as "heavy" as it would seem at first glance but detailed and informative just the same, takes up perhaps a third of the issue. Industrial subjects, engineering, aviation, and criminology are covered. As a sort of dessert, there is included an article on feeding the crew of a battleship which contains some amazing statements by a sailor who has a faculty for making his readers at home in the subject which is his life work.

When Dr. Paul R. Heyl was in our office a short time ago discussing various matters, we asked him to give our readers something to think about. He suggested an article on the quantum, and in this issue we present his views on this intriguing subject. He has even told us how big a thing a quantum of starlight is—about like a barrel. Yet a quantum can get into your eye. How does it do it? Nobody knows. Science frankly admits it doesn't yet "know it all." Many things remain to be found about the quantum.

Sir William Bragg, famous British scientist and winner of the Nobel Prize, shows how man, in overcoming the difficulties presented to him by the things which help him up the road of progress, has devised ingenious methods to aid him in his task, finally discovering the use of X-ray "fingers" for feeling out the atomic structure of matter. He says nothing of those who actually developed this new tool of science but those who are on the inside know that "they" were largely Sir William Bragg!

From Peiping—late Peking, Capital of China—came the article "A 4000-Year Food Experiment," a study of the nutritional equilibrium that has been achieved by China and of the economics of food supply of that overpopulated country. The author, Dr. Adolph, is an American professor in Yenching University, most of the funds for which were raised in America.

Fog, that dread enemy of the airman, is slowly being conquered by new educational methods for student pilots. Major William C. Ocker (promoted from a captaincy since his article was set in type) tells in interesting detail why it is that "flying sense" has often led to crashes in fogs, and what steps are being taken to educate pilots *not* to "use their heads" but their infallible instruments instead.

Professor R. W. Wood, our contributing editor who is famous in the field of physical optics, reviews in this issue the background of the study of scattered light and explains in understandable language the famous Raman effect.

To start the New Year right, we have scheduled several exceptional features. One of these was written at our request by Professor Humphreys, America's foremost meteorological physicist, to answer the question that has been put to us by so many practical people: "If they do succeed in sending a rocket 50 or 100 miles into the air—what then?" He tells in a straightforward, satisfying manner what scientific instruments the Goddard exploring rocket will carry, what facts they will record, and what scientific and practical significance these facts will have.

What is life? No one knows. We may never know But now a Mexican man of science believes he has produced living substance out of the non-living. If his experiments, as described in a coming article, are verified by other scientists, the work will rank as a legitimate scientific sensation. Readers will do well, however, to keep an open mind on the matter for the present.

Coming also is an article to follow up that by Sir William Bragg in this issue. Written by Professor Pullen, also of England, it deals with the practical application of X rays in determining the structure and qualities of alloys used in engineering.

Besides these, there will be in the January issue an article concerning the tremendous developments of modern "alchemists," those who carry on research in the base metal iron and make of it alloys that are "noble" in their strength and utility; one on the fascinating ivory industry; others on aviation, engineering, and oil; and the usual choice selection of smaller articles in the SCIENTIFIC AMERICAN Digest

Orson D. Munn

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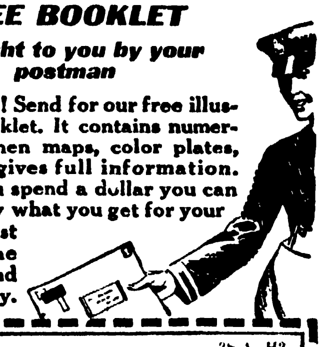

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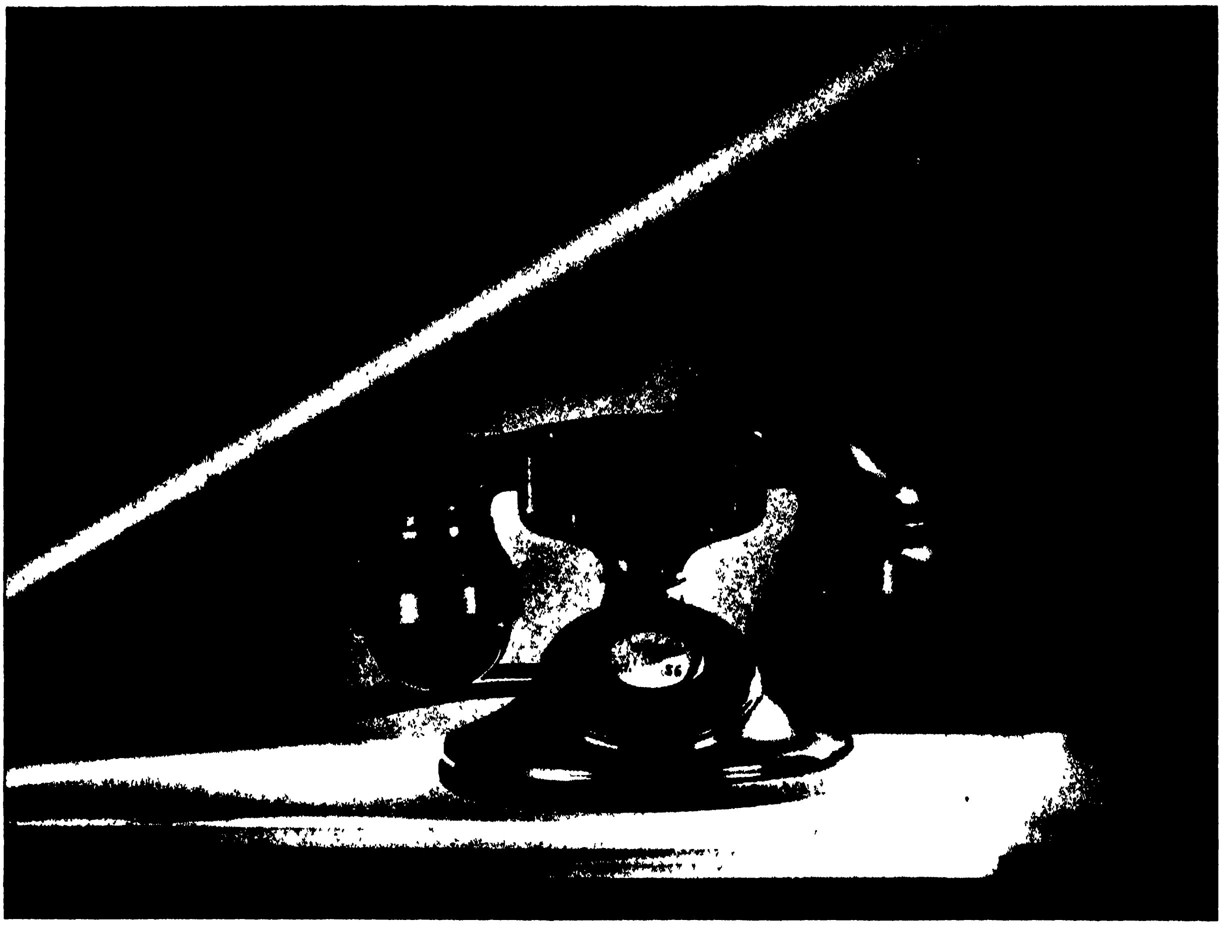

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EIGHTY-SIXTH YEAR • ORSON D. MUNN, Editor

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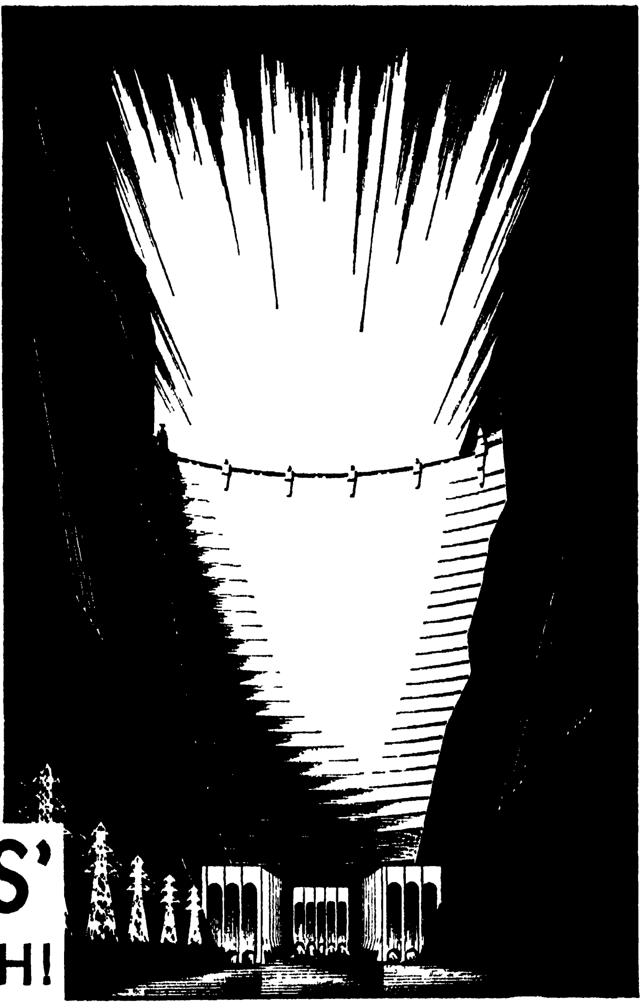
THIS MONTH'S COVER

The painting reproduced on our front cover relates to the article on page 452, and gives an accurate impression of a new experiment which has revealed an interesting phenomenon in physics. At the extreme right is a mercury arc lamp shining through a narrow window. The light passes through a tube containing a solution of iodine in iron tetrachloride (whence the tint suggesting grapejuice) and into the attached tube containing the liquid under investigation. This is blue when illuminated because the molecules of the liquid in it are just the right size to scatter the wavelengths corresponding to blue. Beneath it is a prism which reflects the blue light from the tube above, at right angles (horizontally) into a spectroscope having on the eye end a photographic plate.

STARTED!



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Secretary of the Interior, RAY LYMAN WILBUR, *said regarding the future benefits of the Boulder Canyon project.*

"It is as if our country had suddenly had a new state added to it, for the new and wider use of this controlled water will care for millions of people and create thousands of millions of wealth."

Planning your Pacific Coast plant requires consideration of the Boulder Canyon project... the two are inseparably welded. Foresight today promises rich rewards when this gigantic development is completed, the manufacturing importance of today's Los Angeles will be trebled in the immediate future.

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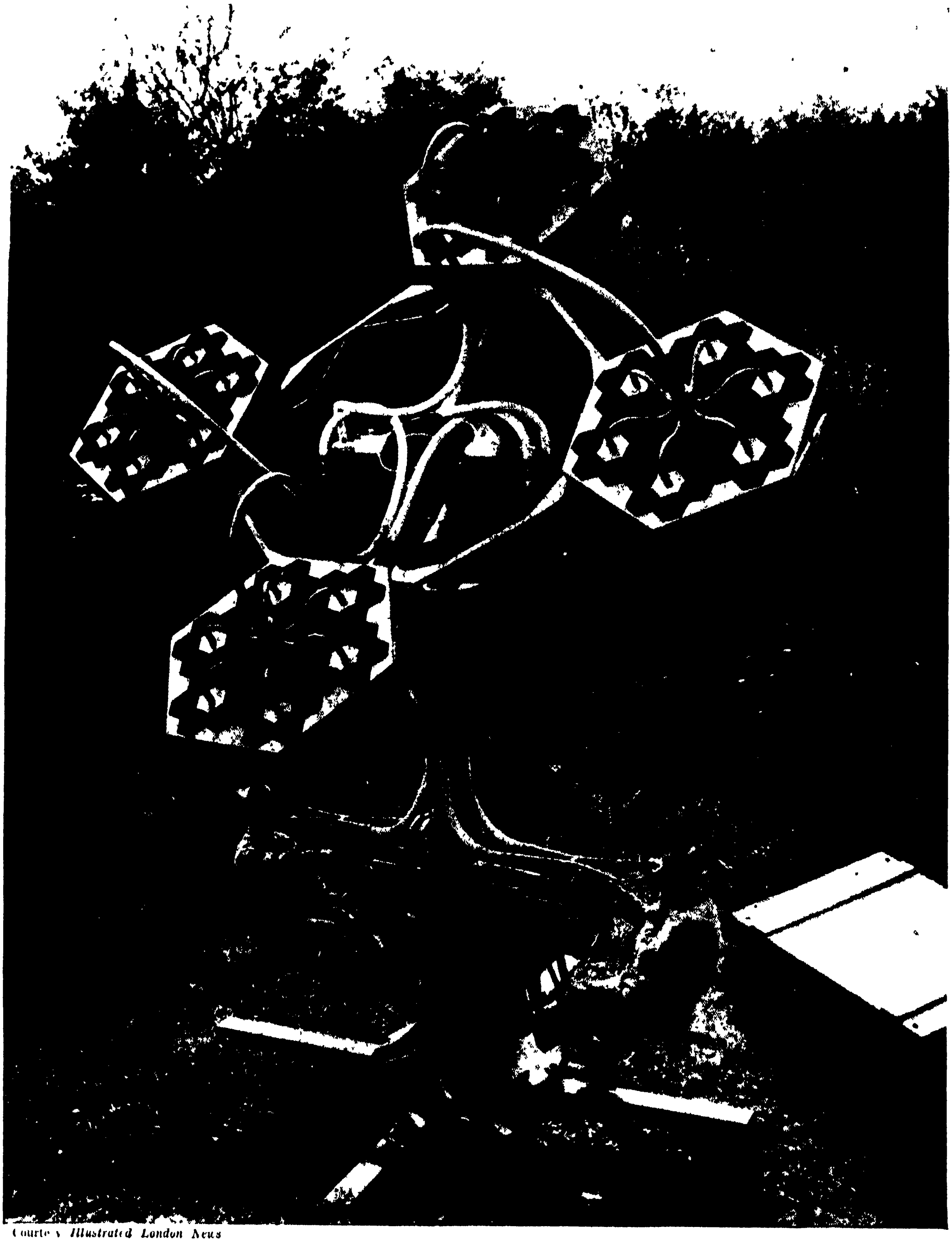
Photo by Troy

TWO SURVIVING PIONEERS

THE first dynamo built in America, like the surviving one of the two Cornell professors who built it in 1875, still is in perfect working order at Ithaca, New York, where it furnishes power to the students' shop in the physical laboratories of that institution. "In 1875" says the physicist Edward L. Nichols in the *Cornell Alumni News*, "Gramme brought out in Paris his form of dynamo machine, and no sooner had the description of it reached this country than Anthony and Moler (Professor W. A. Anthony and Professor G. S. Moler -the latter appears in the picture, which is recent—Ed.) undertook to build one. Long before the first imported dynamo reached America this machine was successfully completed and in operation. With it, before the close of the year, arc lamps were installed on the Cornell campus and were put into regular service, and thus it came about that inhabitants of remote farms among the hills of central New York saw the arc light shine out nights, years before the introduction of this means of illumination in Paris, Berlin, New York, or any of the great cities of the world." Professor Moler told a member of the SCIENTIFIC AMERICAN staff that he and Professor Anthony were forced to wind all the wire with home made insulation. Insulated wire was not available in 1875. The wiring of the outdoor lighting system was underground and the cables were made by drawing copper wire through gas piping and pumping tallow into the pipes, a method which nevertheless proved very satisfactory.



Courtesy *Illustrated London News*

NEW "EARS" FOR FRENCH ANTI-AIRCRAFT GUNNERS

TO keep pace with the great strides made by military aviation since the war—that has been the problem of the anti-aircraft sections of the artillery of all nations. The efforts of the French to do this are symbolized by this new device, by means of which ground crews listen to the approach of an enemy plane, "focus" upon it, and determine its position and altitude. While no details have been released concerning this apparatus, which was tested in recent French aerial maneuvers, it is said to register the sound of planes 20 miles distant. Although aero-detectors have been demonstrated before, this one is interesting because of its novel construction.

Plowing in North China. A man is often a more economical draft animal than a mule

A 4000-YEAR FOOD EXPERIMENT

By WILLIAM H. ADOLPH, Ph. D.

Associate Professor of Chemistry, University of Nebraska.
Recently appointed Professor of Chemistry, Yenching University, Peking.

THE average Chinese lives on but a few cents a day. This is not a myth, nor is it a sign of poverty; it is a simple statement of an economic accomplishment of which China may justly feel proud. We in spendthrift America should at least stop and honestly study China's sane solution of her food problem.

The brief experience of the Occident becomes ridiculously insignificant when compared to the 4000 year experiment which the Orient has conducted on the feeding of large numbers of people. In present day laboratory studies the scientist measures the nutritive value of a diet by feeding tests upon a small colony of perhaps ten or a dozen caged animals. The experiment is brought magnificently to a close after 30 or 40 days, during which the white rats for example have grown or failed to grow on the diet in question, and the conclusions are pronounced with due finality; only recently has it been realized that laboratory feeding experiments must often extend over not only several days, but over several generations before satisfactory conclusions can be drawn.

But here in eastern Asia is a colony of 400,000,000 people who in response to various environmental factors, and possibly racial factors, have adjusted and readjusted their food habits until the present *status quo* was reached! And this condition of established food habits would seem to have remained unchanged for the last thousand years or more.

We, with our new civilization, are still undergoing adjustment to new environmental and economic influences and have not yet reached a state of stable equilibrium. In laboratory experiments, a nutritional equilibrium such as the Chinese would seem to have attained is exactly what the biochemist seeks. The thoughtful nutrition chemist loaded with the faddist lore of the Occident can not but sit as a humble observer before this long term experiment and its accumulated mass of evidence. The Chinese would seem to have sensed certain fundamental principles of food supply long before they were discovered by the up-start West.

CHINA from ancient days has been an agricultural country, and it is still essentially agricultural. Certainly less than 10 percent of the population are found in the large cities and even these are mainly engaged in trade or industry involving agricultural products. The encroachments of the new industrialism may soon begin to alter this state of affairs, but so far there has been little measurable change. The majority of the people eat what they raise. China continues to feed herself largely in terms of a hand-to-mouth operation. The very thoughts of the people, and the language background, are agricultural. A man's wealth in China is expressed not in dollar marks, but in acres of land. An institution in America may possess an endowment of so many million dollars; in China it is endowed with so much land.

The Author

The race for the almighty dollar becomes in China the struggle for land, and this in time produces population pressure. The American and European can calculate the amount of money needed to feed and clothe each member of his household per year. The Chinese glibly reckons this factor in terms of land area, or *mow*. In Shantung, it requires three *mow* to support one man; or, poorer land would be rated as four-*mow* land.

This situation means that practically every available plot of land is under cultivation. Farms may be little more than a single furrow or two hanging on the mountain slope. It is significant that

TABLE I

Composition of the Chinese Dietary
(in percentages by weight)

	China North	United States
Cereals and beans	**65**	**25**
Vegetables and fruits	**27**	**20**
Butter; fats; sugar	**1**	**14**
Meat and fish	**4**	**18**
Eggs	**1**	**5**
Milk and cheese	**0**	**15**
Other foods	**2**	**3**

the size of a family is commonly expressed as consisting of so many "mouths," much as industrial Europe and America refer to so many "hands." The primary aim of each household is to work that bit of land intensively enough to keep the family alive for another half year, or until the next harvest. Ambitions in the big majority of homes do not proceed very far beyond this sphere. This tremendous pressure for a livelihood is not a condition of recent years, but history shows that in very early times there were laws in China regulating the conservation and distribution of food. Our science of national food economics, urged upon us by the World War, is hardly a 20th Century discovery!

A Chinese highway eighteen inches in width effects a saving in land area available for cultivation, which means food for more mouths

TABLE I shows the character of the middle class Chinese diet compared with that for the United States. It is a cereal diet. While these figures are for north China, they are in general true for south China also, except that in the northern third of China the cereal is largely wheat, used as wheat bread, while in the southern two thirds of the country the cereal employed is rice. The common assertion that the Chinese live on rice is therefore only two thirds true. The division into north and south China, that is, a wheat-eating region and a rice-eating region, is a well-recognized one. Habits of life, climate, and agricultural conditions in these two areas also differ greatly. North China has a dry climate; south China is wet. Data now being accumulated for south China, while as yet incomplete, indicate that the only real difference between the dietary of the two areas is in the replacing of wheat by rice. The same fundamental laws of food economics hold throughout the country.

The important place occupied by legumes (this means the soy bean) in China deserves more than passing mention. Of all the varieties of beans, it is nothing short of remarkable that the Chinese farmer-dietitian, thousands of years ago, chose to develop and retain in his agricultural repertoire just that one variety which contained the highest percentage of protein, and also the highest percentage of fat. The soy bean was the one vegetable product which could in any sense replace meat in his dietary. But the soy bean and its wonders is another story.

It is evident that China is not addicted to the meat eating evil. Table 2 shows that the daily food intake represents a total of about 2800 calories. But of this amount, 87 percent is derived from cereals and beans, while only five percent of the calories is supplied by meat and fish. And these data do not represent the farmer class, but are those of the middle class Chinese. Meat is relatively more expensive in China than in America and Europe. The peasant farmer consumes practically no meat at all, except for an occasional indulgence at the time of the Lunar New Year. It is probable that the Chinese approach as near to being a truly vegetarian people as is to be found anywhere on the earth's surface.

Figure 1 is a "dollar diagram" indicating the manner in which the average Chinese family divides its expenditure for food. The Chinese housewife very evidently spends her food dollar in a different manner than do we. It is to be noted that eggs are used only in small quantities; milk and dairy products are conspicuous by their absence.

Meat and cereals are important because of their protein content. Protein of course is the all-important nutritive factor of all foods. The nutrition chemist of a generation ago devoted his energies to determining the total number of grams of protein consumed by the individual per day. It was not then known that the kind of protein was as important as its quantity. We now know that the amount of protein is only part of the story. One hundred grams per day (about 35 ounces) is regarded as the protein requirement for the average adult in the Occident, weighing 70 kilograms (154 pounds). In America we actually consume far more than this amount; the Chinese consumes somewhat less. But when, in addition to this, it is remembered that a vegetarian diet is a much bulkier diet than the meat-containing diet of the Occident, and that the degree to which this protein is utilized in the alimentary canal may be reduced by the very bulk of the food to 50 or 60 percent of its original value, one realizes that the Chinese receives in reality an extremely small amount of protein nutrient daily. In fact, the actual intake for a man of 60 kilogram weight on rice diets may be only 35 or 40 grams (about 14 ounces) per day. This low protein diet again represents a habit of long standing. Have the Chinese indeed accommodated themselves to a lowered protein intake? And if it should be proved that they have done so successfully, perchance the figure for protein requirement which we have established will need revision.

DIETARY surveys show that 91 percent of the protein consumed is of vegetable origin, while nine percent proves to be of animal origin. In America about 80 percent of the protein consumed per day is from animal sources. Much has been written on the relative merit of animal and vegetable protein, of the meat *versus* the vegetarian diet. It is commonly suggested that the aggressive peoples of the world consume large quantities of meat. Table 3, taken from Robertson's "Principles of Bio-chemistry," expresses quantitatively the meat eating habits of the nations. The figure for China has been added to this table by the author and is based on

TABLE II

Composition of the Chinese Dietary

Intake of protein, total energy value, and so on, per man per day (Figures are for North China).

Total food	**1188.0 grams**
Total protein	**86.4 "**
Total fat ..	**34.1 "**
Total carbohydrate	**537.0 "**
Total energy value	**2794.0 calories**
Weight of average man	**60.0 kilos**

observations in Chinese homes and on such trade reports as were available. One wonders whether it is possible to explain certain of the racial characteristics of the Chinese in terms of this low per capita consumption of meat.

That a vegetarian diet rather than a meat diet holds sway in China can be traced to economic factors. The food-consuming animal is a mechanism which transforms food energy into heat or work or even into other forms of food, as into meat for example, which can again be used as food; the animal body, in short, is a converter. Studies in this country during recent years have shown the relationship pictured in Figure 2, which indicates that the transformation by cattle of food cereal into milk or into meat is always attended by considerable loss, a "transformer loss." China in her unconscious way has realized this. At least she has realized that the cereal grains are most economically employed directly as human food.

AND yet this knowledge is not solely unconscious knowledge, for the peasant farmer will tell you that he can obtain a greater return per acre by growing peanuts and extracting the peanut oil than by pasturing a cow in this same field and manufacturing butter or cream—which is merely another variety of oil—from the milk. In fact he knows this so well that for the past thousand years or so he has not even regarded it as worth while to perform the experiment. Just here, incidentally, lies the economic stimulus for our own vegetable oil industry. And we of the West have just come to the stage of measuring these things and have discovered that they are quantitatively true. Do we wonder that China eats little meat and that there is practically no dairy industry!

And the Chinese use of pork is equally startling. Only recently has it been demonstrated by modern science that

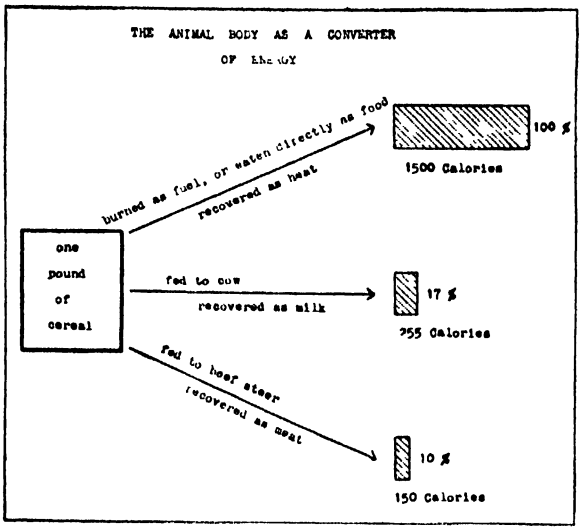


Figure 2

an acre of ground in the form of pasturage produces two pounds of pork for every pound of beef or mutton. So when meat is used in China, it is pork. The laws of economics have dictated far more of the actions of the Oriental than we realize. A man instead of a horse pulls a ricksha because a man is a machine weighing only 60 kilograms and its cost of maintenance is less than that of a horse which is, say, a 600 kilogram machine.

In times of special stress affecting the food supply, such as may be brought about by famine, the farmer tends to dispose first of his draft animal, a luxury. Even when there is no famine at all, it often becomes more economical to hitch a man to a plow than to use a mule. The one-wheeled cart, which requires only a narrow, 18-inch-wide path for its operation and thereby saves more tillable land to the fields on each side of the road, is but another instance of the manner in which economic laws hold the commanding position.

Blind experiment, that guiding angel of the Orient, was kind. It taught the Chinese the importance of vitamins, or at least the importance of vitamin-containing foods. Today, recognizing the importance of vitamins and similar food essentials, we wonder that China not only survived but flourished on a straitened food supply. But China has long been making use of green vegetables, spinach, cabbage, and so on, and fruit. And we of the Occident, having just discovered vitamins, are now busy haranguing our housewives and urging greens in the diet—and often with ill success.

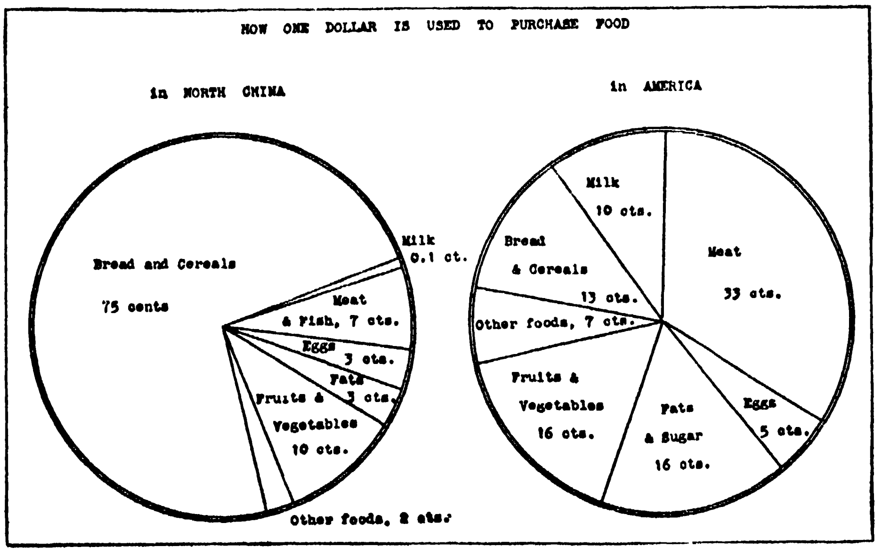


Figure 1

Wheat protein and rice protein are now known to be incomplete proteins, but recent American patents suggest that wheat protein should be supplemented with soy bean flour. Effective combinations like this were in fact *discovered* by the allied food experts during the World War and were served to the soldiers at the front in the form of "war bread." China, on the other hand, has for centuries been making use of similar combinations of protein food materials. In addition to this, infants deprived of the nourishing protein of cow's milk are insured the growth-promoting essentials by being breast-fed till three or four years old.

THE great bulk of the Chinese vegetarian diet is often looked upon by us with suspicion. It is such a considerable factor that the Chinese student coming to America finds it difficult to adjust to the smaller bulk of our more concentrated mixed dietary He asserts that a period of a month or more is required till the digestive system accommodates itself to our small bulk meal. During this period of accommodation of course he finishes each meal with appetite still unsatisfied, and goes hypothetically hungry. We of the West formerly asserted that our type of diet was more concentrated and hence more efficient. But our own dietitians now urge roughage—and more roughage. The Chinese diet however, means a freedom from the multitudinous intestinal disturbances which affect the Occident. Laxative pills are not every-day essentials, and druggists in China must look elsewhere for means of livelihood.

Does the Chinese metabolize on a more efficient plane? Much interest has developed during the past few years in the basal metabolism of the peoples of eastern Asia. A few years ago an experiment at Teachers College, New York, upon a few Chinese women students indicated a much lower basal metabolic rate than would have been expected in the case of American women students. The basal metabolic rate, about which our physicians are beginning to talk in such familiar terms, is nothing but a measure of the energy required just to keep the human engine alive at rest without doing work except that involved in breathing and the other essential functions. Does this lower figure mean, the physiologists all asked themselves, that the Chinese human mechanism is a more efficient machine than that of the European and American? Does it mean, asked the nutrition chemist, that the Chinese people need less food to keep them alive than their American neighbors of equivalent weight?

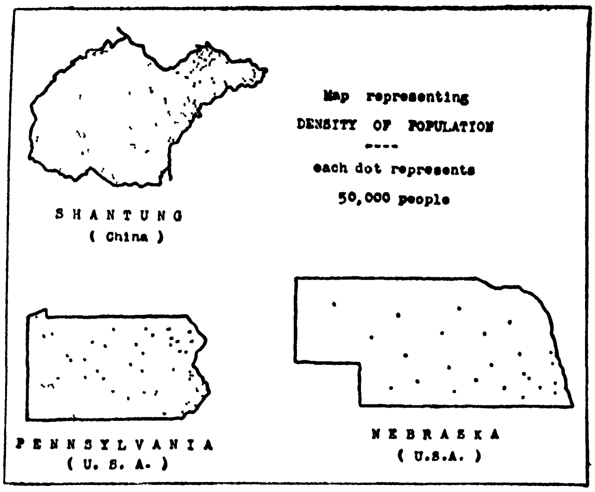


Figure 3

More exhaustive data is now being obtained; portable metabolism outfits have been sent by the Carnegie Nutrition Laboratory of Boston to different parts of the world to settle this point as it applies to the different races. It may be suggested that the lower figure for basal metabolism is the normal for the human race, and that the rush of the Western civilization has merely produced a higher metabolic rate in the Occident, while the philosophic Orient has avoided this abnormal high tension effect. Or the low metabolic rate for China, if confirmed, may merely indicate that the Chinese can truly live longer on a lower ration than is required by the European.

TABLE III

Meat Consumption of the Principal Countries of the World

(grams per capita per day)

United States	**149**
Great Britain	**130**
France	**92**
Belgium and Holland	**86**
Austria-Hungary	**79**
Spain	**61**
Russia	**59**
Italy	**29**
Japan	**25**
China (North)	**15**

Are metabolic traits inherited or environmental? The dietary and metabolic habits of a race presumably either are inherited or are the result of the reactions of environment. The very fact that Chinese leaving China and Occidentals domiciling in China find that certain physiological reactions are temporarily altered would point strongly to environment as the influential factor. North China and south China each represent different types of climate and diet, and when the southern Chinese migrates to north China and adopts north China food, his sons begin to approach in height and weight the higher standards of the northern part of the country.

Environmental factors often do not reveal themselves in a single generation. The Japanese who settled in the United States a generation ago are now developing a larger physique approaching western standards. Cantonese from south China who emigrated to Hawaii are now, after several generations, attaining greater physical height than they did in south China. The blood pressure of Americans moving to China approaches the lower Chinese standard, while Chinese coming to America tend to approach the higher American norm, while the basal metabolism itself of the Westerner moving to south China is apparently lower than it would be at home.

MANY different races now compose the white population of the United States, yet we generally agree that the same physiological standards hold for all of them; at least there have not been discovered among them distinct racial reactions of a purely physiological character. The so-called racial characteristic as distinguished from the environmental factor would therefore seem ultimately to disappear in the realm of food and metabolism.

While it may be a distinct accomplishment to have been able over long periods to feed a nation on a minimum food intake, this habit of merely maintaining an existence has provided no insurance against interruptions in the regular food supply. The tables and figures reproduced in these pages indicate that the Chinese people live constantly on the fringe of starvation. There is absolutely no margin or reserve. A famine in China is primarily a violent disturbance of the delicately balanced economic *status quo*—so violent that the common people find it difficult or impossible to buy food. Drought, floods, grasshopper pests, revolution, are disturbing agents. And they are usually augmented by ill-developed means of communication, such that the areas with excess food supplies can not automatically unload their surplus unconsciously, as is done in America, on the regions where the demand is high and the supply low. One crop failure in a district brings about enormous suffering; two crop failures result in famine and starvation; and three successive crop failures in the same district produce havoc and devastation.

MOREOVER, human beings in China do not always die of starvation to the extent that they die from disease caused by a weakened physical condition. Food intake and health are closely related and famine studies show how a very slight lowering of the quality and quantity of food intake produces immediate disaster.

China, while receiving credit for a finely balanced solution of her food supply problem, is at the same time face to face with the fact that the prosperity of the nation demands not mere maintenance, but an optimum metabolism expressed in terms of improved growth and vigor. It is hardly to be doubted that in this modern age, with its new demands, China will rise to a solution of these newer problems with all the thorough-going capacity which she has displayed in the past.

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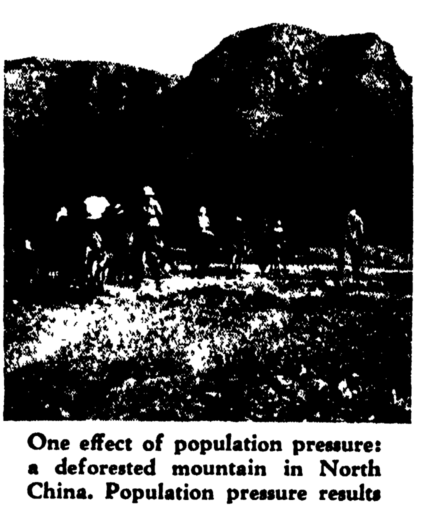
When Professor Goddard's exploring rocket soars 50 or 60 miles aloft what scientific instruments will it carry? What will be their purpose and what the practical value of their findings? Next month this will be explained clearly and simply.—The Editor.



One effect of population pressure: a deforested mountain in North China. Population pressure results in the unconscious discovery of some valuable methods, such as hogs as the most efficient source of meat, but the deforestation that also occurs is not one of these

OUR POINT OF VIEW

SPEND FOR PROSPERITY

UNTIL a few months ago, there was, among industrial and business men and all people of the thinking class, a feeling of optimism regarding the economic depression, an optimism not of the Pollyanna sort but rather of a constructive nature. Many splendid plans were advanced as possible means of stimulating business recovery but nothing much has been done toward adopting any of them. And now, even the thinking optimists, as well as the Pollyannas, have turned lugubrious pessimists.

What is the matter with the American people?—that "race" which is famed for and vaunts its ingenuity, industriousness, and ability to the world. They are not unaccustomed to slumps; they've had them before. Where is that comeback, that fight, that will-to-win, bear-for-punishment spirit? Are they, to whom the world looks for a certain amount of guidance and, unfortunately, with envy and hate sometimes, because they *have* possessed a progressive spirit and an acquisitive instinct—are they to be cowed, to admit defeat and wait for someone else to start the world back toward normal conditions? Usually only the mongrel dog slinks away, whining, with his tail between his legs.

The country is not in such a bad state, after all. September disbursements of dividends to shareholders were nearly 76 millions of dollars more than for September, 1929. There was a large increase in the number of dividends omitted and reduced, but the total disbursements were 475,094,394 dollars compared with 399,391,264 dollars in September, 1929. This can mean only one thing: that while many businesses have suffered losses, many others profited far more than they did before the slump. There may be drawn from this the conclusion that if some can prosper, others can at least make a new start and grow. But somehow it hasn't seemed to work that way.

Long-established and vital industries that have withstood for months the laments of the pessimists, have at last succumbed and inaugurated programs for retrenchment that are sure to have a devastating effect, not only because they will withdraw many millions from circulation but also because they will further lower the morale of all those who hear of them. And the distressing part of it all is that our greatest customers, the American workingman and the small-salaried office man, are always the first to feel each new blow. They are discharged in hordes without the slightest prospect of obtaining other employment. Their purchasing power is lowered, business suffers further, and old man "vicious circle" is at work again! And even the man with a job becomes frightened at the possibility of losing his source of income and hoards his money "against a rainy day"—more money out of circulation!

DANIEL GUGGENHEIM

IT is our sad duty to record the death of Mr. Daniel Guggenheim, capitalist, philanthropist, and patron of aviation, on September 28 at the age of 74. Known chiefly to the country at large as the donor of the Daniel Guggenheim Fund for the Promotion of Aeronautics and vaguely as a "copper king"—vaguely, because while his power was tremendous, it was quiet—his interests spread over the world like a far-flung empire.

Mr. Guggenheim's business ability and progressiveness brought continual success to his endeavors but as his power grew, so apparently did his humanity also grow. Identified with the early romance of American mining, expanding his interests to other fields, and ever persistent in his encouragement of scientific research in industry, he yet had time for art and music and flowers. He gave liberally yet quietly, dealt fairly with all, and was imbued with a public spirit that few could equal.

In the death of this valued citizen his friends have suffered an incalculable loss. But his greatness transcends the limits of ordinary personal friendship; in him was the warmth of a great soul, a warmth that radiated outward through contact with him and his philanthropies to touch thousands whose lives, expanded and made finer because of him, shall be his greatest memorial.

In a case such as this it is easier to diagnose than to prescribe. One thing is certain, however, and that is that the American people, collectively and individually, must start a veritable orgy of spending. They must stop hoarding for a while, stop being frightened, stop crying "hard times" and put money into circulation, thus creating a great demand for all sorts of things the manufacture of which will make the wheels hum again and bring a return of prosperity. Time enough, after that is accomplished, to save!

Along with others, we have given up hope for any real help from business itself, and now appeal to the individual. And if that individual is one of those who persistently passes the buck to the other fellow, who is always perfectly willing to "let George do it," we venture to say that if he doesn't cooperate this time, the other fellow, George, may get his job!

INTERNATIONAL AFFAIRS

The Deplorable Cut In Naval Personnel

WE are convinced that the recent announcement by the Navy Department of a contemplated reduction of 4800 enlisted men in the Navy will be a distinct disappointment to the American people, a large majority of whom are willing to be taxed for the support of the Navy. The unplausible attempt to connect this reduction with the provisions of the London Conference will not impose upon the general public, who were only recently told by the Administration itself that a large new building program would be necessary to bring our fleet up to the allowed treaty strength. Obviously, ships without men are useless, so the proposed cut means either that the Administration has no intention of building a treaty fleet or that it does not propose to man it after construction.

The accompanying statement that our fleet is to become a "training nucleus" will still further alarm our people who have been taught to believe that a large standing army is unnecessary because our fleet would be maintained as a sure and ready shield, behind which our skeletonized peace army could expand to war proportions. Now we are to have a skeletonized navy as well as a skeletonized army. The term "training nucleus" has a comely sound, but the American people have too long regarded their fleet as their first line of defense to be charmed by any new catchword, however beguiling.

We also fail to see the consistency of the Administration discharging 4800 sailormen in the present condition of unemployment, while at the same time it requests private employers to refrain

(*Please turn to page 486*)

INSTRUMENT FLYING TO COMBAT FOG

By WILLIAM C. OCKER

Captain, Air Corps, United States Army

WHEN F. Trubee Davison, Assistant Secretary of War in charge of aviation, climbed out from under the covered cockpit of one of the planes used for instruction in blind flying on a recent visit to Kelly Field, he voiced the experience of many other pilots who have flown under covered cockpits or in fog, the actual weather condition which the covered cockpit simulates.

"I don't know what it was exactly," Mr. Davison said, "but something went wrong and when I tried to turn, I didn't know where I was."

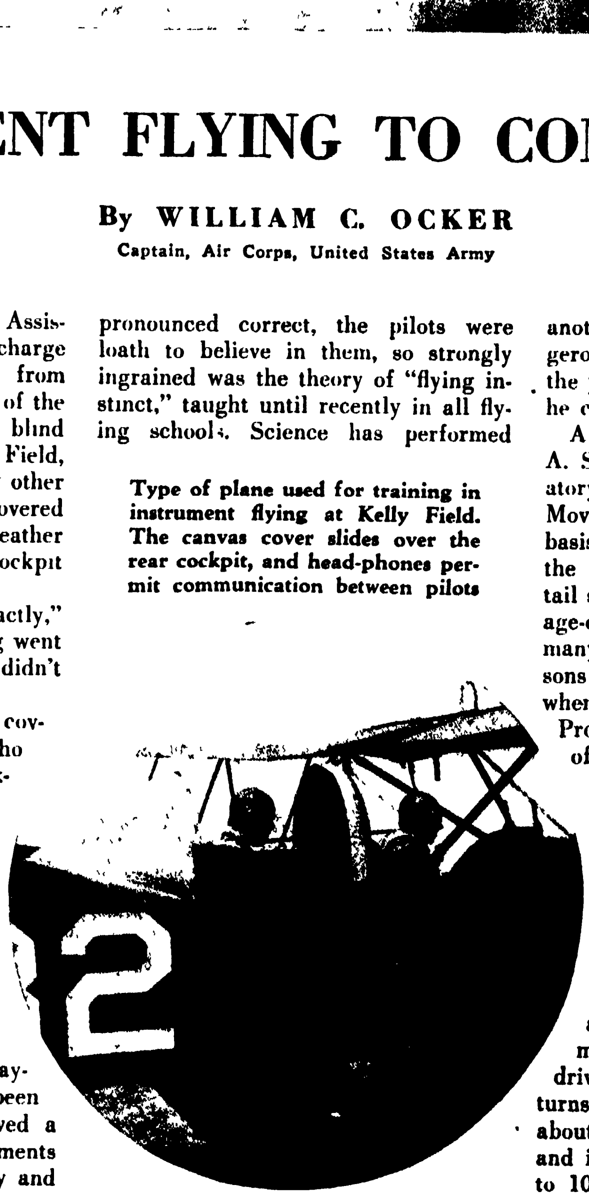
It was the first experience in a covered cockpit for Mr. Davison, who has a reputation for being an excellent pilot; he was more fortunate than some other pilots in that he was thoroughly convinced beforehand that his instruments were going to be right and his senses were going to be wrong. Failure to realize this fact has resulted in many crashes, no small percentage of which have been fatal.

That the instruments went "haywire" is a report that has often been made by pilots who have survived a crash in a fog. Even when instruments were later returned to the factory and pronounced correct, the pilots were loath to believe in them, so strongly ingrained was the theory of "flying instinct," taught until recently in all flying schools. Science has performed another service in exploding this dangerous theory—that a pilot can "feel" the position of his plane in a fog when he cannot see.

A comprehensive report by Prof. A. A. Schaeffer, of the Zoological Laboratory, University of Kansas, on "Spiral Movement in Man" seems to be the basis of the problem and may answer the question of why pilots go into a tail spin when they get into a fog. The age-old belief, found in the folklore of many races and nationalities that persons go around and around in a circle when they lose their way prompted Professor Schaeffer to conduct a series of experiments which led to the following conclusions:

"When blindfolded persons walk or swim in what they intend to be a straight path, 300 or more steps in length, they actually walk in a more or less regular clock-spring spiral. The same is true when driving an automobile blindfolded or when a blindfolded person in an automobile calls the direction to the driver. The diameters of the spiral turns in walking or swimming vary from about six meters to about 30 meters, and in driving an automobile from 12 to 100 meters. These spiral turns are

Type of plane used for training in instrument flying at Kelly Field. The canvas cover slides over the rear cockpit, and head-phones permit communication between pilots



not due to any asymmetries in the legs or other parts of the locomotor organs of the body generally, such as right-handedness.

"ONE and the same person may walk or swim or drive both right spiral turns and left spiral turns in different experiments or sometimes in the same experiment. No apparent difference is observed in the direction of turning that is referable to difference in age, sex or right- or left-handedness. Spiraling is not a conscious phenomenon. Consciousness gets no direct repeat from the spiraling mechanism. A blindfolded person is conscious of swimming or driving a straight path when he is actually going in spirals. The spirals are smaller, however, when the attention is not intensely directed on the manner of making each step, but is occupied with counting the steps or thinking about something else than walking a perfectly straight path.

"Persons who lose their way in forests, snowstorms, and fogs go around in circles because, in these persons, the orientating senses are not functioning and then the spiral mechanism guides the path. Rabbits, foxes, antelopes, and other game, when hard-pressed in the chase, lose the power of orientating themselves through fear and then the spiral mechanism also leads them around in circles."

This tendency to move in spirals is not lost in the air. It is rather further complicated by the addition of a third dimension with which the pilot must cope. Professor Schaeffer's report and the experiences of many pilots while flying through fog lead to the belief that this spiral tendency may work in the third dimension and such a compound tendency may readily cause a plane to become tilted at almost any angle while the pilot still believes himself flying on an even keel. Under such a condition, while flying in fog, it would be quite possible for the plane to be tilted at a stalling angle without the pilot realizing it.

To correct this spiraling tendency and enable us not only to walk in a straight line but to maintain our equilibrium, Nature has endowed us with a number of senses, chief of which are the sense of sight, the vestibular sense, deep muscle sense, and the tactile sense. Tactile sense, or the sense of touch, is of considerable importance on the ground but in the air, with heavy clothing and within closed cabins, this sense is reduced to a minimum and plays only a minor and insignificant part and may be disregarded entirely so far as maintaining equilibrium or a straight course is concerned.

Deep muscle sense, often alluded to by pilots as "feel of the ship" or "seat sense," includes sensations resulting from stimuli from the muscles, tendons, bones, joints, and internal organs. The pilot has been taught to lay great faith in this sense. There is no known method for accurately measuring this sense but the thoroughly trained pilot appears to develop it and interpret the stimuli to a much greater degree than others. Deep muscle sense is far from being infallible in maintaining equilibrium, however; many pilots have come out of fog to find themselves off their course, with a wing up or down, and even with the plane upside down.

The vestibular sense is derived from that portion of the inner ear which has to do with equilibrium—the semi-circular canals, the saccule and the utricle. These are considered the chief motion perception organs and have been the subject of many investigations as being of great importance in flying. One of the simple tests which have been devised to indicate the accuracy of the vestibular reactions can be made with the Barany chair, a revolving chair with control attachments.

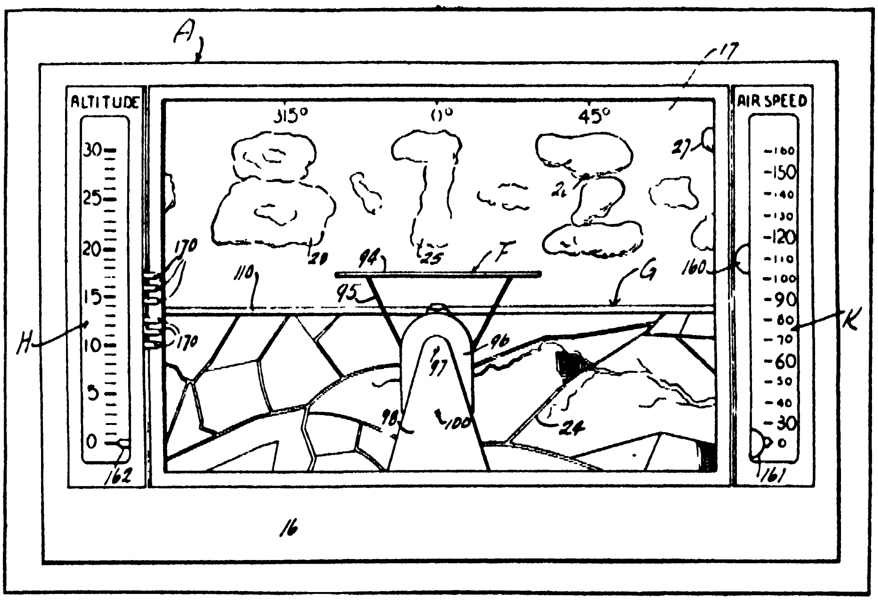
THE vestibular reactions are controlled by the semi-circular canals of the inner ear, which are at right angles to each other. By reason of their position, they are stimulated by changes of position of the individual and stimuli received by these organs are interpreted by the brain as sensations of motion. The stimulation of the canals and the reactions observed by rotation in the Barany chair are similar to those produced in actual flight, although the subject is not actually in a spiral dive or

Captain Ocker and Major Mileau, flight surgeon, giving a test with the Barany chair. After a few turns in the chair with his eyes closed, the subject almost falls out of the chair due to effects of vertigo or dizziness

***At right:* Close-up of instrument box for use with Barany chair to show illusions caused by vertigo. *Below:* Method of using instrument box with Barany chair. Slide removed in both cases to show instruments**

tail spin. When rotation stops, the sensation of vertigo, or dizziness, results. If the subject in the chair is questioned after a few turns, it will be found that this sensation of dizziness is actually a sensation of rotation in the opposite direction to which he is being rotated. The individual has no control over these impulses.

Although it is known from actual experience in aviation and from experimental work that the erroneous impression derived from the repeated stimulation of the labyrinth of the inner ear is subject to decrease and duration, no normal person has been known to overcome this illusion entirely. The vestibular sense, then, is one of the senses which govern equilibrium, but without the sense of sight it not only is useless but is actually dangerous because of the illusions it creates. The sense of sight is important on the ground but is much more so in the air.



Flight integrator invented by Lieutenant Carl J. Crane and the author. At the left of painted landscape is the altimeter; at right, the air-speed indicator

THIS special sense is, of course, not infallible for there are such things as optical illusions—a mirage for example—but it is certainly the most reliable. Through sight alone are we able to take bearings on our position and calculate our approximate position in regard to a given point. So long as our sight is not impaired, we may reasonably expect to remain orientated.

Equilibrium in the air, then, depends first on the sense of sight, then on the vestibular sense, deep muscle sense, and last upon the tactile sense. In flying in fog, this sense of sight also fails as there is no fixed point outside of the plane, no horizon to aid in orientating the pilot. The solution of this problem is to have absolute confidence in the flight instruments, such as the bank-and-turn indicator, the inclinometer, and the rate-of-climb indicator. In this connection an interesting psychological problem arises.

Until very recently, all flying students were taught to disregard flight instruments and trust entirely to their "flying instinct" even in fog. As a result, pilots taking the blind flying training, flying by instruments under a covered cockpit, find it hard to disregard their instinct, which they are thoroughly convinced is a handicap without sight, and to trust their instruments implicitly. The older pilots at Kelly Field taking blind flight instruction learned less easily than the younger pilots or the flying students in whom the flying instinct theory had not been so deeply ingrained.

After the pilot has been convinced that he must disregard his instinct, instrument flying is principally a matter of co-ordination. He has been accustomed to moving his hands and feet in accordance with stimuli produced by a landscape at various positions relative to the nose of his plane. In instrument flying the stimuli are produced by various dials which must be read and interpreted before the controls can be manipulated properly. This mental process causes confusion at first but can be managed so that the average pilot can bring his plane out of spirals and spins and fly a triangular course of some distance with considerable accuracy after about 10 hours of training in the covered cockpit. Flying by instruments alone is more fatiguing than ordinary flying and also requires some practice in the covered cockpit when actual fog flying is not possible to "keep in training."

Several new instruments have been developed to lessen the strain on pilots who must fly by instruments alone, of which the Sperry company's directional gyroscope and artificial horizon are two. When a pilot wishes to make a turn of 90 or any certain number of degrees, the magnetic compass is unreliable because it spins when the plane is banked. The directional gyroscope does not spin and the pilot can tell immediately when the desired turn has been made. The artificial horizon shows the pilot the position of his plane relative to the horizon, indicating the angle the plane is banked and whether it is climbing or gliding.

THE flight integrator, invented by Lieut. Carl J. Crane and myself, is still in the experimental stage but gives promise of reducing fatigue and also decreasing vertigo caused by the rotation of the plane in a spin or power dive. It consists of a miniature plane silhouetted against a landscape painted on an endless belt. As the plane turns to the right, the background moves to the left, giving the pilot watching the miniature plane the illusion of turning similar to the impression he would receive were his vision not cut off by fog or the covered cockpit, as the case may be. Skidding or slipping is indicated by tipping of the miniature plane. A narrow white band stretched across the landscape rises above or falls below the horizon to indicate that the plane is gliding or climbing.

An altimeter reading vertically will be placed on one side of the integrator and an air-speed indicator at the other. Thus five instruments will be combined in one, making it unnecessary for the pilot to "chase all over the board" to figure out what the plane is doing, and the plane's movements will be shown directly, eliminating the mental process which is one of the chief causes of fatigue in blind flying. Vertigo is also minimized by the moving screen. When the plane stops turning, the screen stops moving and the pilot is able to orientate himself in a very short time.

The value of being able to fly in fog is readily apparent. It greatly increases military efficiency to be able to fly in all kinds of weather. As for the commercial field, it will increase safety and decrease the number of trips which must be cancelled because of bad weather, principally fog. Only one problem remains—that of landing in fog. When this is solved—and indications are that it will be, in the near future—the menace of fog which has long been aviation's most formidable enemy will be conquered.

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¶ *A railroad executive was intensely interested in the intricate details of railroad signalling systems as described in an article soon to be published. We warrant you will be, too.*
—The Editor.

ELEVATED HIGHWAY TO SPEED TRAFFIC

WHAT will be the finest, and perhaps the greatest, highway of its kind in the world, is now under construction in New York City. Built along the Hudson River waterfront, this highway, which may be listed as one of Borough President Miller's important achievements, begins at the Hudson Tunnels at Canal Street and will extend to Spuyten Duyvil, a distance of 14 miles. The lower section, up to 72nd Street, will be elevated 14 feet above the street level. From 72nd Street, it will be a beautiful boulevard covering the tracks of the New York Central Railroad completely.

The entrance ramp of the elevated highway at busy Canal Street

Ramps will be provided at 23rd, 42nd, and 57th Streets, reaching the center of the elevated roadway so that no cross traffic will occur. This will permit a speed of 40 miles an hour, resulting in a traffic capacity of 5000 vehicles an hour. Approaches will be constructed at nine uptown points, beginning with one at 72nd Street. The roadway will be 60 feet wide to accommodate six lines of traffic and will have the most modern signal system for traffic control, fire and police protection. The architectural design will take care of the esthetic as well as the practical values of the structure.

The first section between Canal and 22nd Streets is now nearing completion and may be opened for traffic before this article is printed. Construction of this section involved many difficulties, one of the worst of which was the building of concrete foundations for the 400 columns in waterfront land that was filled in years ago with all kinds of waste materials, soil, and stones.

This great structure will aid greatly in solving New York's north- and southbound, long-distance traffic problem. It is understood that the plan calls for double-decking some time in the future.

Cars coming up either of these ramps pass directly into the traffic stream

Fourteen-foot clearance of the highway on a broad street

Nearing completion: lower section with paved roadway

X-RAY FINGERS FEEL OUT THE ATOMIC STRUCTURE OF MATTER

By SIR WILLIAM BRAGG, F.R.S.

Director of the Royal Institution of Great Britain and of the Davy-Faraday Research Laboratory.
Nobel Prize Winner. Author of "Concerning the Nature of Things"

MAN, having the power to forecast the result of overcoming difficulties and the wish to try to overcome them, has devised various ingenious methods to help him in his task. Taking first of all the difficulties that depend on the inadequacy of his vision he has invented the microscope which gives him the power of seeing details thousands of times too fine to be perceived by the naked eye. The spectacles that many of us use may be looked on as making a small step in this direction.

The power over the handling of materials has been enormously increased by the microscope. It has been the chief instrument in the study of metals and alloys, so that whole new branches of metallurgy and metal working have depended upon its use. It is fundamental to the study of the minutiae of fibers, so that textile industries depend on it more and more. It is, of course, the main weapon of the biologist and the bacteriologist upon whom so many sciences rely, such as agriculture, and all the economic development of plant life. In fact the microscope has immensely increased our powers of perceiving the small things and invisible conditions which must be treated sometimes as dangers, sometimes as objects of welcome usefulness. It has widened and enriched our world.

BUT there is a point which the microscope can not pass. With its aid we perceive what is very small, but not the "very very" small. There are regions of minuteness which it can not ever penetrate. The limit is set by a curious natural barrier; natural because it depends on the nature of light. If all the small things which mattered to us were contained within the barrier, there would be no need to try to surmount it, but this is not so. Wide as the fields are which the microscope has opened to us, far wider fields lie outside its range: fields which also contain events and things of first importance. There are details of the structure of the living cell, essential features in the composition of metals, cotton, silk, rubber, paint, bone, nerve, and a thousand other things which are hidden even from the microscope, and must always remain so hidden because the failure does not lie with the skill of the optician but with the incapacity of light itself.

Let us look a little more closely at this curious fact. The process of vision begins first with the emission of radiation from some source. Without illumination nothing can be seen. The nature of radiation is in many respects a mystery, but we know enough about it to understand that we may talk of it in many of its important aspects as waves in some medium which we call the ether. The eye is an organ designed to perceive these waves. If we turn our eyes towards the source of radiation they are filled with the sense of light. If the radiation falls on any object, it is turned aside and modified in various ways. When our eyes are directed towards the object, they take in the modified rays, and we have learned by long practice to know, from these modifications, the nature of the object that has made them That is "seeing."

THE central point of the process is the act of scattering and modification. Now waves have a certain wavelength, and common experience of such waves as may be seen, for example, on the surface of the sea tells us that an object which is very much smaller than the length of the wave has no appreciable effect upon it. The wave rolls past a cork on the surface without showing appreciable traces of modification, but a rock or the side of a steamer may actually turn it back again. In just the same way there may be objects which are so small that they can not affect a ray of light, and such objects are forever invisible in the ordinary sense. The length of the light wave which our eyes can perceive lies within a short range on either side of a fifty-thousandth of an inch. An object of such small dimension can indeed affect a light wave, but the parts of the object do not produce obvious separate effects, so that we can not do much more by the aid of light than merely detect the object as a whole. We can see nothing of its details. There are smaller objects which we can not even perceive.

Now such details and objects can be of fundamental importance, as we have already seen. What shall we do now?

The X rays break down the barrier for us, and admit us to this immense field in which we want to be. They do so by virtue of their character as light waves, 10,000 times or so smaller than visible waves, but of exactly the same nature. They have all the necessary characters for modification by the "very very" small objects on which they may fall. We have only to ask, then, how they may be used and perceived, for our eyes fail entirely to detect them.

It happens that there are various ways in which they can be registered. One of the simplest and most convenient is by the process of photography. The plate or film which is made sensitive to light can, fortunately, also perceive the X rays, though our eyes have not this double power.

So far, so good. But we should not be able to go farther were it not that nature builds her structures on certain most interesting principles. Let us look into this matter also.

WE can take the atoms as the elements of all the substances that we use or handle in any way. We know that there are some 90 kinds of atoms of which a few vastly surpass the rest in numbers; oxygen, silicon, and aluminum heading the list. A piece of pure iron contains nothing, of course, but iron atoms; the point of great importance is that the atoms are not merely jumbled together anyhow, but are arranged very perfectly according to a simple pattern which is not very difficult to picture. Suppose a pile of cubical blocks to be made so that they lie in rows in three perpendicular directions. Think of the corners of these cubes as points in space. Put an atom of iron at each corner, or perhaps one should say, at each point where eight cubes meet. Place also an atom at the center of each cube and allow the cubes to vanish. There the iron structure is complete.

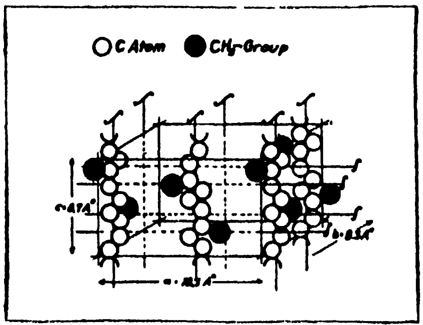
The structure of a piece of copper is even simpler. The atoms are arranged as in a pile of cannon balls, just as they are shown beside the guns in the old pictures. The structure of a diamond is rather more difficult to apprehend from a verbal description; it may, however, be grasped if it is remembered that each atom of carbon has four neighbors at equal distances from it and equidistant from each other. And so we go on to more and more complicated structures. The distances between the atoms are very small, we must remember; they vary about a mean of something like the forty-millionth of an inch. They are, of course, invisible, even in the microscope.

If a substance is such that all the atoms which compose it are arranged on one and the same pattern, so that the straight rows run through from side to side, the substance is a single crystal; crystalline character meaning, simply, perfect arrangement. Single crystals are, of course, common enough, such as jewels, salt, sugar, and a host of other kinds of substances, occurring, for example, in great frequency in the chemist's laboratory. But most substances, and especially those we handle every day, such as the metals, must be described as masses of small separate crystals. In fact a single crystal of a metal is rarely seen, and is a most curious object. A copper bar which is but one crystal throughout can be bent between finger and thumb like a piece of stiff clay. But in the very act of bending the complete uniformity disappears; the mass breaks up into small crystals. The bar loses its extreme plasticity and after a little handling becomes as stubborn as copper usually is.

THE fact is that in many kinds of crystal there are special directions in which planes can be drawn or conceived to be drawn, and the atoms on one side of such a plane can slide more or less easily over those on the other. They are called glide-planes. When the copper bar is one crystal throughout, it is easy to make this slipping occur. But when the bar is multi-crystalline, the planes of easy slipping are not the same for all the crystals, because the latter are oriented in different ways. However we try to deform the bar, there are always some crystals which resist being deformed in that particular way. And the various crystals back each other up according to some principle which we do not fully understand. Thus the properties of the bar depend upon its crystalline character.

The small crystals of which it is composed are often visible to the naked eye, and very often to the microscope. It is for this reason that the microscope has been of so much use to the metallurgist. But though the microscope can do and has done so much, it is only the X ray that can tell us the internal arrangement of the crystal, and it is only by becoming expert in the use of X rays that we can hope to unravel further the marvelous complexity of the relations between structure and properties.

If this is true of the simple metal, it is also true of the complex alloys, the properties of which are of such extreme importance in modern industry. We learn for example that iron, when treated sufficiently, changes the arrangement of its atoms to that already described as characteristic of copper. With this change its properties change also. If certain substances, carbon or manganese, for example, be added to the iron, the reverse change may be prevented, even when the temperature is once more brought back to normal. Thus the properties of iron in the second state may be retained and this is sometimes very desirable.



Courtesy of *India Rubber World* (New York)

The elementary unit of stretched rubber is found to consist of atom groups each about .00000087 millimeter in length, arranged as shown

More generally the properties of an alloy depend not only on its composition but also on the nature of the crystals which the components form, on the sizes, forms, and relative orientations and dispositions of the crystals. And this is true, to some degree at least, of all substances. In fact, when Nature builds up a substance she tries always to put the atoms together in regular order and according to a regular pattern. The crystal is always arrived at. Generally, however, the attempt to carry the structure of a single crystal through the whole of a visible mass is only partially successful and not obvious. The X rays often surprise us by showing that crystalline structure exists where we had not expected it; for example, in cotton, silk, stretched rubber, bone, and so on, and we may be quite sure that the crystalline tendency is part of the plan and contributes to the desired character of the structure.

IN conclusion, let us now consider briefly the method in which the X rays are employed to examine the crystalline structure of any body. To describe it with any fulness we should have to use the diffraction principle of physics and other principles as well. But a general understanding can be reached by readers through less accurate means. Let us remember that to make any object perceptible by the use of radiation we must allow the radiation to strike the object which then scatters and, it may be, modifies that which strikes it. The scattered rays are received by the eye or the photographic plate or some other suitable apparatus. They are registered and we use our brains to judge by the result the nature of the object.

The X rays are of short enough wavelength to be turned aside or scattered by the atoms, when longer light waves are not. A single atom can, however, do very little. What apparatus we possess can only be effective if immense numbers of atoms act together. Here is where the regularity of crystal arrangement comes in. The unit of pattern is repeated an enormous number of times even in a crystal just visible to the naked eye. Whatever one of these units does in the way of scattering, all the others do in regular order. The combined amount is perceptible, and so the crystalline character is detected.

Sometimes we have watched a flock of pigeons flying over the town roofs in the evening and have seen that, as they wheeled, the sun's rays have flashed back at the same moment from the under surfaces of all the wings. Then the flock has for an instant been a notable object in the sky. The analogy is very imperfect, as everyone will see who knows the laws of diffraction, but it may serve to illustrate the method in which the X rays are used. The rays are made to fall upon the crystal which is turned about in all ways. Then at certain moments the position of the crystal is such that all the component units act in unison and a reflected ray flashes out from the crystal of a magnitude that may be perceived.

OF course this is an indirect way of examining the structure. We do not perceive the individual atoms; we discover only their arrangements. But the knowledge so gained can be combined with other knowledge that we already possess and we have actually found ourselves able to decipher the patterns of Nature to an extent we did not dream of a few years ago. We have a new field of knowledge, a new branch of science which is in fact the physics and chemistry of the solid. Its exploration gives us unexpected but most welcome information about the fundamental design of solid materials, organic and inorganic, living and non-living. It promises to fill a wide and serious gap in our previous knowledge and to give results of the greatest interest and importance in relation to science generally and in particular to the use of science in industry.

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In an early issue a more detailed article on the X-ray analysis of crystals, especially with regard to the study of engineering materials, will be published.—The Editor.

A FACT-FINDING FACTORY

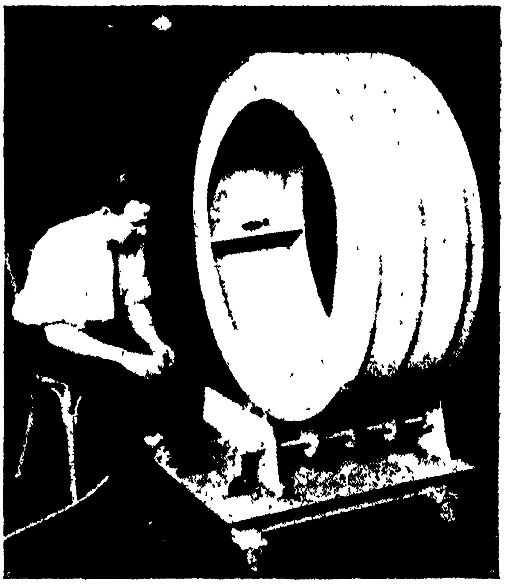
WE are frequently asked for information on testing laboratories that can be utilized for special problems by concerns and individuals who themselves do not have enough work of this kind to warrant the expense of maintaining their own laboratory. In response to the demand we present in this article the story of the availability and resources of a particular laboratory, as typical of the development along this line. Should you have problems of this kind we will be glad to give such information as we can.—*The Editor.*

THE purchasing problem is one which is always with us. It is easy to obtain prices for comparison, but unless prices are coupled with some indication of quality they do not guide efficient buying. Recognizing this fact, some of the larger industrial companies, railroads, and the government bureaus, have established laboratories for determination of the quality of materials purchased. The general public up to this time has had to be satisfied with makers' or sellers' guarantees or representations and word-of-mouth endorsements from users, in addition to such judgment and experience as are available. This problem is very much in the foreground at the present time, as witnessed by such movements as that of the Federation of Women's Clubs, the Consumer's Research, Inc., the various "institutes" maintained by publications, and so on, which endeavor to supply a service in recommending to members or subscribers the various appliances, devices, and supplies which after inspection and test can be recommended as satisfactory for purchase.

There is an observable movement also on the part of manufacturers of some classes of goods, principally in the engineering fields, to grade their own products and to issue such products under labels which the manufacturer guarantees will be affixed only to materials of a certain specified quality; for example, in recent advertising of pineapple products, a page advertisement was devoted to pointing out to the public the marks upon the cans which denote the various grades supplied. Some of the lumber manufacturers are guaranteeing the qualities of the gradings of lumber which they identify by branding the grade upon each piece of lumber.

THE real difficulties in this situation are that first, testing is expensive; and second, that the expense of testing is justified only when the quantities at stake are large enough; for example, it would not pay the individual purchaser of an electric refrigerator to have tests made upon all the existing types for the purpose of discovering whether he is purchasing the most efficient device for home use. Such a procedure would cost tens of thousands of dollars while his expenditure for the refrigerator would perhaps be 500 dollars or less. But if the purchaser is buying many units, or if there are many purchasers who wish this information, then the testing can be combined so as to make it not only an economic possibility but a really profitable proposition.

Acting on this premise, the Association of Edison Illuminating Companies over 30 years ago pooled some of its testing problems, and Electrical Testing Laboratories is the outgrowth of this co-operative effort. The people behind the laboratories have been far-seeing and have equipped the institution so that at the present time it is an organization open to the public in general where testing equipment and experts are available for investigations of many diverse problems and the equipment provided is very extensive and complete.



An electrically operated tumbling barrel ready to test the appliance plug on shelf

It is true that the bulk of the tests and investigations carried on at the laboratories are electrical in character but many of these involve problems outside the electrical field which demand collateral investigations. For example, the investigations of the quality of power cable bring in the study of the composition and properties of lead, copper, paper, and insulating oils, all of which are the component parts. In addition these components must be subjected to mechanical tests for strength, effect of distortion, and so forth, and electrically, tests must be made to determine the conductivity of copper and the electrical strength of the insulation. Studies must also be made of the effect of heat and cold, the heating effect and consequent deteriorating effect of time, heavy current, and so on, so that it is

A straw hat maker wanted his hat tested to find the heat inside as compared with that within a felt hat

An abrasion machine for testing appliance cords is an example of machines designed to test to destruction

necessary to provide very large and expensive equipment and even more important, a staff of experts who can bring to bear on the testing problems a wide variety of experience.

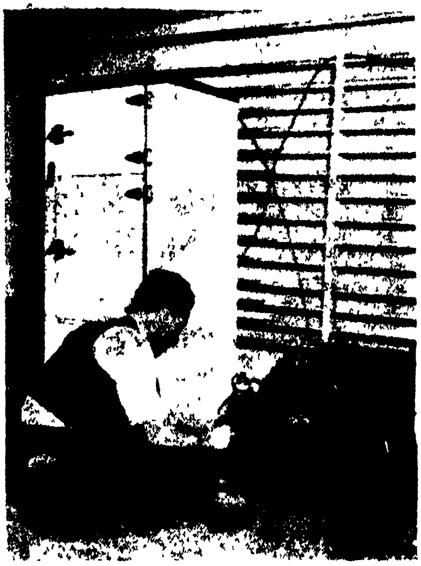
At the present time, these laboratories occupy several buildings situated at the corner of East End Avenue and 80th Street, New York City, comprising 66,000 square feet of floor area. There is a force of 325 people, 225 of whom are engaged in work at the main laboratories and 100 who are traveling or resident inspectors located at various factories from Boston, Massachusetts, to Oakland, California. Traveling inspectors visit practically every state.

THE magnitude of the work which is done can best be realized when it is explained that tests made by this laboratory in the past year covered the inspection and testing of over 300,000,000 incandescent lamps, 9,000,000 feet of power cable, over 1,000,000 porcelain enameled steel reflectors, design tests of all of the automobile headlamps in use in 20 of the eastern and central states, besides some 8000 miscellaneous tests for large purchasers, manufacturers, and consulting engineers covering many varieties of electrical apparatus, and appliances. Many thousands of electrical safety devices, such as rubber gloves, linemen's protectors, overshoes, leggings, insulated tools, and so forth, are regularly inspected and tested.

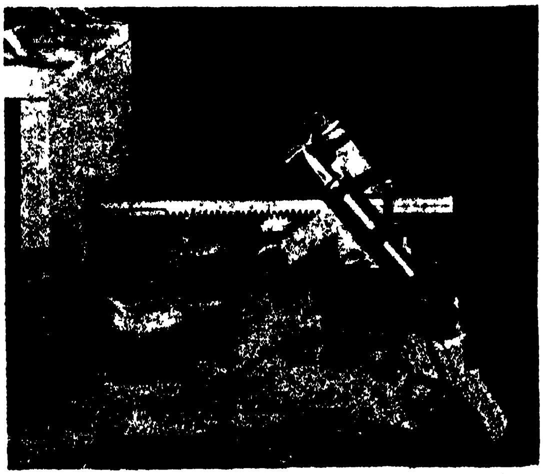
In the chemical department analyses have been made upon such diverse materials as steel, coal, paper, soaps, typewriter ribbons, pencils, insulating varnishes, oils, gasoline, boiler compounds, water, and fuel oils.

During the past year, a very interesting investigation has been carried on for the electric light and power companies which comprise the Association of Edison Illuminating Companies, on electrical appliances which are used in the homes served by these companies. Samples of all types of electric flatirons, simple and automatic, over 50 different models of electric ranges, 150 appliance plugs, 100 types of appliance cords, many percolators, electrical refrigerators, toasters, and so forth, are being tested, in many cases to destruction, to find out their serviceability, so that these power companies may be in a position to recommend to their customers appliances which give good efficient service for long periods with a minimum of repair and readjustment.

The photometric department performs many services. In addition to the measurement of incandescent lamps, it makes tests upon lighting fixtures, search-lights, flood-lights, and flash-lights. Tests are also made by this department on the illumination of artificially lighted premises such as offices, banks, railroad terminals, and lighted streets. It is sometimes called upon for tests of artificial and natural lighting, in connection with damage suits, both personal and as the result of restriction of natural lighting. Many tests of this kind are also made in connection with the determination of the validity of patent claims.



Testing an electrical refrigerator unit in a specially equipped room



A machine that will substitute for a lot of shaves in determining the life of a safety razor

Perhaps the most interesting examples of testing are those which may be termed "freak" investigations. For example, a dead goldfish was submitted by a hotel in New York with a request that a determination be made of the amount of copper sulfate in the body of the fish, it being thought by the client that the fish was poisoned by the absorption of copper sulfate from a copper tank in which a large number of fish were kept in the hotel lobby. A manufacturer of cigarettes submitted a number of brands of cigarettes to determine the heat of burning the cigarettes under normal smoking conditions in order to prove an assumed superiority of one brand. Three brands of golf balls were tested for relative resiliency. Samples of procelain-enameled iron were submitted for tests of deterioration of the enameling under acids which might be encountered when metal table tops are subjected to ordinary kitchen usage. A manufacturer of straw hats submitted his product for test in order to find the relative heat inside the straw hat as compared to the heat inside of felt hats, the hats being exposed to direct sunlight.

Filling rubber gloves with water as part of an electrical leakage test

IN this category also may be placed the tests made for investors who wish to know something about the value of an invention or process in which they are considering investment of capital. For example, a gasoline substitute was submitted, which upon analysis was found to be composed of a fair grade of gasoline with a small admixture of lubricating oil to give it color. A rechargeable dry battery was found to be simply a good dry cell of a standard type with a new label substituted. A storage battery compound, warranted to increase the capacity of any lead-sulfuric acid storage cell, was found to be made of corn starch which had no beneficial effect. A new type of airplane cloth reinforced with very light but strong steel wires designed to add materially to the strength of the material was subjected to mechanical tests. A so-called "electric therapeutic" device, which it was alleged had effected marvelous cures of rheumatism and sci-

A view of part of the mechanical laboratory where tests for thermal conductivity, valuable to manufacturers, are being carried out on various steam-pipe coverings

atica, proved upon investigation to be a nickel-plated cylinder filled with sealing wax.

It is not only in exposing obvious frauds that these laboratories function. These constitute but a small though interesting fraction of the work of the laboratory. It functions often in connection with the development of processes which are brought to satisfactory and successful results. There may be cited in this class the Klaxon automobile horn which was designed by a client of the laboratories, working in a private shop and submitting from time to time the results of his labor for tests. Several manufacturers of insulating varnishes have used tests developed in the laboratories in connection with their own experiments in the blending of varnishes not only to increase the insulation resistance of their varnishes, but also to increase the length of time that the varnished cloth or paper made up with their compounds would remain pliant. A manufacturer of diffusing glassware, by continued experimentation, designed a form of translucent glass which transmits a considerably larger amount of the light falling upon it than was apparent in the first samples submitted.

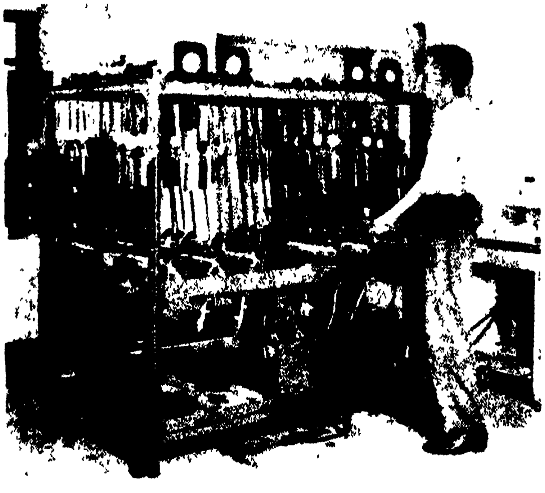
DURING the World War, manufacturers of star shells for lighting battlefields at night, by constant test and experimentation of various mixtures, increased the illuminating power of such shells from 10,000 candlepower with a burning period of 30 seconds to over 100,000 candlepower with a burning period of a minute and a half, eliminating also a great deal of the flicker which was characteristic in the first samples. In all these cases, the tests were made for the manufacturers upon samples which they fabricated using the formulas which had been suggested or proved by repeated tests.

After a cable has been tested on over-load, insulation is inspected

As was indicated previously, this institution is called upon from time to time for tests in connection with legal controversies. In such cases, the laboratory prefers to be retained if possible by both sides and to make the results of its tests available to both parties in the action. As examples of this type of service, there may be cited a test which was made to determine the electrical resistance of a pair of shoes which had been worn by a lineman who had been killed by an electric shock; the testing of a street lighting installation to determine the compliance to specifications of the street lighting equipment used by a power company; the measurement of natural light reaching the windows of a building; the measurement of the loss of light occasioned by changes in the construction of the Manhattan Elevated Railroad in New York as a basis for determining the compensation to be paid to owners of adjoining property. Very often in such cases the variation in natural lighting is so great as to make it impracticable to obtain complete measurements on the actual premises. In such cases, a few check measurements are made in actual position and a scale model is constructed which is artificially illuminated. An exhaustive study of the model is made, in this way eliminating all the variable features except those that are in question.

IT is to be expected that an organization of this kind is called upon from time to time to make tests for inventors whose hopes for success are greatly in excess of the merits of their inventions. In such cases, the attempt is made to dissuade them from spending money foolishly. In the 34 years of existence of this institution, there have been submitted perpetual motion machines, direct-current transformers, lighting appliances which are designed to multiply the total flux of the original lamp 100 times, electric generating machinery for producing more than 100 percent of the power put in, mechanical and electric water heaters of 200 to 300 percent efficiency. The problem in these cases, a diplomatic one, is to dissuade the inventor and at the same time to convince him that the laboratories are not the agent of the trusts which are engaged in keeping back improvements which might revolutionize industry and thereby destroy invested capital.

Many more instances of the variety and interest of the work might be given but the bare outline which is presented indicates the wide variety of effort which is characteristic of the testing problem, the diversity of the clientele which must be served, and the value of constant continuous research as an aid to betterment of conditions, the safeguarding of human life and property, and the encouragement of progress.



Electric appliance plugs get hard usage in service; this machine tests them more severely

FEEDING THE CREW OF A BATTLESHIP

By **JOHN DONALD THOMPSON**
Chief Boatswain, U. S S *West Virginia*

THERE are, no doubt, many hungry people within the broad domain of Uncle Sam, but if so, certainly they are not to be found upon his fighting ships. Food, selected and inspected, the finest in the world, is most plentiful. Carefully guarded, refrigerated, cooked hygienically and served under supervision from the cleanest of dishes fresh from electrically operated dish-washing machines filled with distilled water, boiling hot, the food reaches the men in its most tempting condition.

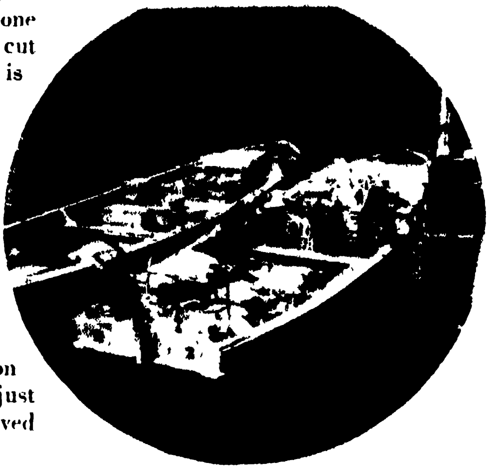
One hundred and ninety turkeys; more than 2000 pounds for only one meal! It sounds like a great deal, but it is only for a holiday, the fourth of July or Christmas, dinner to which must be added all the other good things that go with such feasts. The men, the boys that man the fighting ships are, most likely, far from home, but otherwise the holiday meal is just as tempting and complete. Then, to this must be added the novel surroundings of life on board ship and an appetite whetted by regularity, salt air, and wholesome exercise. On the fourth of July, at noon, 2000 pounds of turkey disappear from the plates of the eager boys as if by magic; the well rounded out menu is reproduced on this page.

I passed by the metal-screened door of the butcher shop where the head butcher was carefully explaining to a lady visitor (and as many other visitors as could crowd into the doorway) his daily labor in providing the meat portion of the daily ration for 1300 men.

"Why," she exclaimed, "a ham will last us ever so long, even if we are all at home—and every one of us is a hearty eater!"

"Yes'm," he patiently explained, "I guess so, but 50 hams makes just one meal for us. It is boiled, then we cut it up and serve it out; none of it is ever left over. Lots of other stuff goes out from the issue room and the galley up forward. Beef? Oh yes, we use lots of beef. We cut up about 850 pounds of hind quarters into beef steak with this machine for one meal; then it is fried in the galley. Seven hundred and fifty pounds for veal cutlets and only 500 for stew. Six hundred pounds of halibut makes the noon meal on Friday; besides this, just about every sort of meat is served at various times."

Lots of times when I pass the butcher shop I look in through the large round port hole; usually they are all busy cutting up meat or cleaning and polishing up the shop.



Boxes, bags, crates: two 59-foot motor launches at the gangway with provisions

All photographs by the author

INDEPENDENCE DAY

4th of July, 1930

•M•E•N•U•

Sweet Pickles
Green Onions
Queen Olives
Celery Hearts
Pineapple Salad
Sweet Mayonnaise
Cream of Celery Soup
French Croutons
Roast Imperial Turkey
Celery Stuffing
Giblet Gravy
Creole Potatoes
Buttered Squash
Sweet Corn on Ear
Sunshine Cake, frosted
Blackberry Pie
Neapolitan Ice Cream
Cigarettes
Coffee

Any doubt that our sailors are well fed will be dissipated by one glance at the menu at the left and at the healthy, happy faces in the illustration above. During such a holiday meal, 2000 pounds of turkey disappear from the plates of the sailors

WE have thousands upon thousands of visitors from every state in the union, no matter what port we may happen to be in. Many men are detailed as guides to show them about the ship and make them feel at home. Sometimes I act as a guide myself, though not so often now, and it seems that all visitors, especially women, invariably ask to be shown, the "dining hall, the kitchen, and the pantry." So we take them down below and show them the great deck spaces hundreds of feet long and from 30 to 50 or more feet wide; this, they are told is the "dining hall," or more simply, the mess deck. From here, they are shown into the large galley that is lined with huge oil-burning steel ranges and steam-jacketed kettles manned by a dozen white-clad cooks busily preparing the next meal, the savory odors of which invariably bring forth exclamations of delight. This, they are informed, is the kitchen. They leave this attractive place of activity, of pleasing odors, with many a backward glance and exclamations of wonder.

"Now," confided one attractive young matron, "I must see the pantry. They may cook in a galley, but there must be a pantry." So the party was shown into the compact and abundantly stocked issue room with its snow white tiled deck and glistening shelves, its rows of polished bins, barrels of pickles and vinegar, rows of sacks of sugar and beans, and the untold number of things that go to fill the pantry, or as we call it, the "issue room."

"And this," said the guide to the attractive young matron, "is the pantry."

After marching forward on one deck and aft on another without having seen anything resembling a dining table, the party is sure to ask where the tables are. They are then pointed out, neatly stowed in pairs on iron racks overhead between the beams. Each table is fitted with folding iron legs, as are the little benches that fold up and are stowed on top. When taken down and set up for use, they seat 10 men quite comfortably. One mess consists of 20 men using two tables and served by one mess cook, or a total of 21 men. The number of messes varies somewhat, but averages around 65.

The mess cook, who does no cooking at all, brings the food from the galley, the bake shop, and the issue room, and the dishes from the scullery. He also washes the knives and forks, besides cleaning up the deck and a considerable portion of the paint work in the immediate vicinity. Then once each week he has to take the tables up on deck and scrub them with sand and bleach them out in the sun.

On deck in bright sunlight, the daily inspection of shiny coffee pots and dish pans

If it so happens that a mess cook is good in bringing down "seconds" from the galley, the boys give him a lift now and then with the work and of course help in stowing the tables overhead. After a period of time, usually three months, the detail is relieved. Sometimes they stay for many months on this duty and seem to like it. When I was a mess cook, food was rather scarce and I was well pleased when I went back on deck.

The dishes are washed in a scullery where the far famed "scullery maid" would have found delight, for in their metal racks like eggs in a carton, the dishes for 1300 men are washed and stowed in from 14 to 19 minutes with an electrically operated dish washing machine having a crew of four men and one checker. After having been washed they are stacked, in their own racks, upon shelves, all ready for the next meal.

Visitors note with satisfaction the "spud coxswain" and his gang of a dozen or more men as they busily prepare vegetables in the vegetable-locker adjoining the galley. About one ton of spuds, or potatoes, are prepared each day. Two electrically driven peelers make quick work of about 20 sacks, then each one is gone over by hand for spots. If required, they are passed through the slicer for French fry, or go into the steam-jacketed kettles to make the well known mashed potatoes. Celery, lettuce, cabbage and, in fact, just about all vegetables are prepared only by the crate.

In looking over the accounts I note that the boys have used in one half month, 10,000 pounds of cantaloupe besides 8000 pounds of watermelon and 1500 pounds of various berries. Eight hundred pounds of green onions must have been a lot of onions, but it went along with 10,000 pounds of green corn; 1500 of lettuce; 2000 of cabbage and a like amount of celery; 1400 of ripe tomatoes; and 1000 of bell peppers, and numerous other items that would appear small, being, as they are, under 1000 pounds. Fruit is served much more than is commonly believed —practically every day if possible. If fresh fruit is not available, the canned article is used.

In the preparation of vegetables, 20-gallon steep-tubs are used. In the cooking, either the 40- or the 60-gallon steam-jacketed kettles are used. The same kettles then come in handy when cooking macaroni, stew, beans, and numerous other standard articles of diet while the long row of steel, oil-burning ranges is principally used in the preparation of meat. One of the principal troubles encountered with meat is that it has to stand for some time after cooking before it is served; this has never tended to improve the quality of meat.

Having passed through the wide, white-tiled galley with its long rows of huge kettles and ranges, the visitor comes to the coffee pot. A shining copper urn of 120-gallon capacity, majestically it stands beside the galley door. Its eager daily visitors are legion, for be it known that "Jamoke" has ever played a most important rôle in the daily life, and it might be said, the night life, of both the old-time shellback as well as the sailors of the modern man-of-war.

Coffee is served out to the crew at 5:30 each morning; then once again for breakfast and at noon. Tea or cocoa is usually served with the evening meal, but coffee drinking is general throughout the ship both day and night, especially by the men on watch. The daily inspection of coffee pots is a pretty sight. The mess cooks are lined up in formation in spotless white uniforms with aprons, each with his shining coffee pot and bright dish pan.

Once outside the galley, the door of the bake shop stands invitingly open, while from within issue tempting odors of newly baked bread mingled with that of spiced pies and delicious pastries. Inside this Aladdin's shop, huge electric bake ovens silently perform their tasks while the electrically driven dough mixer vies in slow rhythm with the lively tune of the cake mixer.

Stacked in neat array against the steel bulk-head, ready at hand, you observe many tons of flour and sugar besides the ample stock of ingredients that go to make up the bread and pastry shop of the ultra-modern man-of-war.

For the time being the visitor is apt to think that the navy is simply a place ingeniously equipped for the preparation of food, for hardly has he passed out of this novel bakery when he is confronted with another galley entirely different from anything seen before. This time the roaring ranges are presided

The dishes are stowed in metal racks like eggs in a crate. After being washed, they are stacked, in their racks, ready for the next meal

over by men of different races: Filipino cooks, Negro cooks, and sometimes a Japanese. This is the officers' galley where these mixed races deftly ply their art. From this galley, a sparkling gem of efficiency, go the very choicest foods in the world to the officers' mess.

When necessary to provision ship, usually once each month, a day is set aside for that purpose. About 100 tons of provisions, consisting of both fresh and dry stores about equally divided, are taken on board that day. About 50 tons are tinned and sacked stores while the rest is all of the fresh or perishable variety. The meats are frozen and go into the refrigerator while most of the fruits go into the chill room with the eggs, the butter, and the cheese.

SOME of the articles loom rather large. Of beef there will be 20,000 pounds and of sugar a little more. Flour soars to 30,000 pounds while potatoes top the list and run between 40,000 and 50,000 pounds. Coffee keeps well above 1500 pounds; pork loins run about 4000 pounds while one ton and a half of hams skimp sadly by. Bologna and "franks" are slightly less and 1500 to 2000 pounds of chicken or turkey simply means one meal. Five thousand pounds of butter together with 3000 dozen eggs fried with 1500 pounds of bacon finishes a good many breakfasts to the fighters of the nation's first line of defense. Six thousand cans of milk are used each month in cooking and in coffee, while 600 pounds of yeast finds its way to the bake shop.

On one day each week a working party of some 25 men are engaged in bringing up provisions from the well-stocked store room to the commissary issue room. This issue room presents a most imposing appearance. It resembles a fully stocked grocery store minus any perishable articles except fruit and is presided over by a specialist in commissary work, who is a diplomat capable of keeping the crew contented and the captain satisfied—a task of no mean proportions. An army is said to travel on its stomach; a navy, then, might be said to sail on its stomach with the commissary steward as the chief pilot supported by his ample store rooms filled to capacity with practically every known article of food on the market, in the finest condition, ready to weather the storm.

Every week a bill of fare is made out for each meal that is to be served; in the case of holidays a blank is left and a special printed menu is made out. These bills of fare are posted in all branches of the commissary department. Then the cooks, bakers, butchers, and the men in the issue room can make all preparations to furnish all the items listed, and in the exact quantities required.

The number of men to be fed each day varies; men are received and transferred; others go on leave or to the hospital, so that a definite number is never possible to count on for any great length of time. Yet there must be plenty of food without any additional allotment of money. Great care must be exercised or the ration, usually 50 cents per day, will not be sufficient. It is remarkable that such a bill of fare as that for the first three days of a week, reproduced in these columns, can be maintained at that price.

Imagine the great amount of fine detail work necessary to combine the numerous combinations of food in the large quantities required, in order that each man may sit down to his meals on the exact minute, three times each day during the year.

The Issue Room and the desk from which all orders of food are issued. The ship's pantry

The mess tables are scrubbed with sand and bleached in the sun on deck

BILL OF FARE *for the* GENERAL MESS

Beginning June 30th, 1930

	BREAKFAST	DINNER	SUPPER
M O N D A Y	Cantaloupes, Cornflakes, milk, sugar. Scrambled eggs, braised bacon. Lyonnaise potatoes. Vienna rolls. Bread, butter, coffee.	Vegetable soup. Crackers. Grilled beef steak, onion gravy. Mashed potatoes. Steamed peas. Shirred lettuce. Apricot pie. Bread and coffee.	American chop suey. Steamed rice. Boiled sweet potatoes. Tapioca-fruit-pudding. Bread, butter, tea.
T U E S D A Y	Cantaloupes. Boiled hominy grits, milk, sugar. Fried pork sausage, pan gravy. Creamed potatoes. Parkerhouse rolls. Bread, butter, coffee.	Cream of tomato soup. Saltines. Pot roast of beef, brown gravy. French fried potatoes. Boiled cabbage. Sliced tomatoes. Mincemeat pie. Bread and coffee.	Fried hamburger steaks. Worcester gravy. Boiled new potatoes. Macaroni-Italian. Beet-onion salad. Chocolate pudding. Bread, butter, tea.
W E D N E S D A Y	Oranges Baked pork and beans. Tomato catsup. Hot corn bread. Bread, butter, coffee.	Bean soup. Saltines. Fried pork chops. Country gravy. Mashed potatoes. Corn on cob. Boiled turnips. Shirred lettuce. Pumpkin pie. Bread and coffee.	Fried beef liver. Onion gravy. Boiled potatoes. Mashed summer squash. Green onions. Watermelon. Bread, butter, tea.

MORE ABOUT PLUTO

By HENRY NORRIS RUSSELL, Ph. D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

EVER since the discovery of the new planet Pluto it has been eagerly observed at many places. More than a hundred accurate observations of its place in the heavens have been secured, and from these a rich harvest of knowledge has been reaped. The numerous observations of March, April, and May improved our knowledge of the orbit so much that, figuring backward, its position in past years could be calculated and images of the planet, in some cases very faint, were thus identified on photographs taken at Uccle, Belgium, in 1927, at Yerkes in 1927 and 1921, and at Mount Wilson in 1919. With these available the observed arc of the planet was multiplied twenty fold.

The calculations of Crommelin in England, and of Bower and Whipple in California, based on this fuller material, agree closely and leave no doubt outstanding about the main characteristics of this most interesting object. First and foremost the claim of the newcomer to rank as a planet is decisively confirmed. Though the eccentricity and inclination are greater than for any of the eight principal planets which were previously known, they would pass as moderate among the asteroids and there can be no hesitation in assigning the new body to the ninth place among the sun's more important attendants. There is nothing cometary about it at all; its orbit is far too near a circle and it is eight or ten times as far away as the distance at which even the brightest comets fade out into complete invisibility.

THE early calculations which indicated a highly eccentric orbit turn out to have been upset by a small error —only three seconds of arc— in one of the earliest photographic observations, made with a telescope of comparatively short focus and a long exposure. How such a small departure from exactness may be enormously magnified by the process of calculating an orbit was explained last month. In the second place the orbit, now that we know it, is found to be so similar to that which Lowell predicted from his calculations 15 years ago that it is quite incredible that the agreement can be due to accident. Setting prediction and fact side by side we have the following table of characteristics.

	Predicted	Actual
Period	282 years	249.17
Eccentricity	0.202	0.254
Longitude of perihelion	205°	212° 30′
Perihelion passage	1991.2	1989.16
Inclination	about 10°	17° 9′
Longitude of node	not predicted	109° 22′

Lowell saw in advance that the perturbations of the latitudes of Uranus and Neptune (from which alone the position of the orbit plane of the unknown planet could be calculated) were too small to give a reliable result and contented himself with the prophecy that the inclination, like the eccentricity, would be considerable. For the other four independent elements of the orbit, which are those which Lowell actually undertook to determine by his calculations, the agreement is good in all cases, the greatest discrepancy being in the period, which is notoriously difficult to determine by computations of this sort. In view of Lowell's explicit statement that since the perturbations were small the resulting elements of the orbit could at best be rather rough approximations, the actual accordance is all that could be demanded by a severe critic.

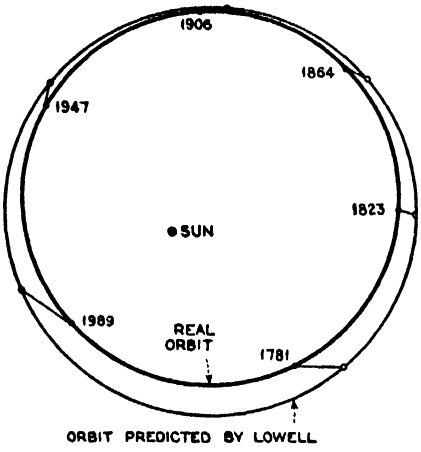


Figure 1: Actual and predicted orbits

Even so, the table does not tell the whole story. Figure 1 shows the actual and the predicted orbits, the real positions of the planet at intervals from 1781 to 1989, and the positions resulting from Lowell's calculations. It appears at once that the predicted positions of the orbit and of the planet upon it were nearest right during the 19th Century and the early part of the 20th, while at earlier and later dates the errors rapidly increased. Now this (speaking broadly) is just the interval covered by the observations from which the influence of the planet's attraction could be determined and, therefore, the interval in which calculation could find the position of the planet itself with the least uncertainty.

In the writer's judgment this test is conclusive. If someone should maintain that a calculation based on wholly insufficient data (and hence physically meaningless) might by some strange bit of luck result in predicting all four of the important elements of the orbit with the relatively small errors shown above, he would still have to account for the fact that the outstanding errors are so *adjusted* that their influences partly counteract one another and bring about the closest agreement of prediction and fact—just at the time when a genuine prediction, based on physically significant data, would have behaved in the same way!

IT may be remembered that substantially the same thing happened in the case of Neptune. Both Leverrier and Adams had assumed that the distance of the unknown planet agreed with Bode's "law," and had therefore taken it much too great. Their calculations made the orbit considerably eccentric (though it is really very nearly circular) but this spurious eccentricity brought the predicted orbit toward the sun in the region where the planet actually lay at the time, and went far to undo the error of two original assumptions. They still had the distance too great, however, and the predicted mass of Neptune was therefore considerably larger than the real value. There were some critics then who maintained that these discrepancies showed that the discovery of Neptune was only "a happy accident" but it has long been acknowledged that these critics were wrong, and the full credit for the great triumph of mathematical analysis has gone where it deserved to go.

History seems this time to have repeated itself closely, except in one tragic detail—Percival Lowell did not live to see his prediction thus fully confirmed. In only one particular was he seriously wrong—he overestimated the apparent brightness of the planet more than ten fold. Several causes probably contributed to this. Pluto is somewhat nearer to Uranus and Neptune than he supposed, hence a small mass would suffice to produce the observed perturbations. Within a year or two—perhaps sooner—someone will doubtless make the necessary calculations and determine the mass of the actual, rather than the predicted, planet. We may guess that it will turn out to be four or five times the earth's mass, instead of six. Even so, it is evident that the planet must be of high density and its surface of surprisingly low reflecting power. But speculation on these matters may well be postponed until observations with the greatest telescopes, under the best conditions of seeing, which will undoubtedly be made this winter, tell us more about the planet's actual diameter.

THE relations between the orbits and motions of the new planet and those of Uranus and Neptune are curious enough to deserve mention. According to Bower and Whipple the mean distance of Pluto from the sun is 39.60 astronomical units (we may note in passing that this is close to the distance predicted by Bode's "law," 38.8, for the next planet beyond Uranus, but we will be wiser if we attempt no explanation). This puts the new planet, on the average, about 900,000,000 miles farther from the sun than Neptune. But the eccentricity is so great that the distance at aphelion is 49.7 and at perihelion 29.55—which is less than the perihelion distance of Neptune (29.82). If the two orbits were in the same plane they would intersect and there would be a chance of a collision. But the high inclination of Pluto's orbit keeps him well out of danger.

Figure 2 shows the orbits, Pluto's being projected on the plane of Neptune's orbit and a little foreshortened, which apparently brings its perihelion farther in. At the points where they appear to cross, Pluto is high above Neptune. The orbits are nearest at point A where the distance is 2.6 astronomical units (240,000,000 miles). This looks considerable, but when compared—as it should be—with the distance from the sun, it turns out to be by far the closest approach among any of the principal planets—when the two planets are nearest their distance from one another is only one twelfth of the average distance from the sun, while at the next closest approach between the earth and Venus this fraction is about three tenths.

Such close approaches are, however, very rare. The period of Neptune is 164.77 years, that of Pluto according to latest calculations is 249.17. (The computers, however, point out that on account of the observational errors this value "is determinate to about a year" and we must not draw conclusions from the last two figures.)

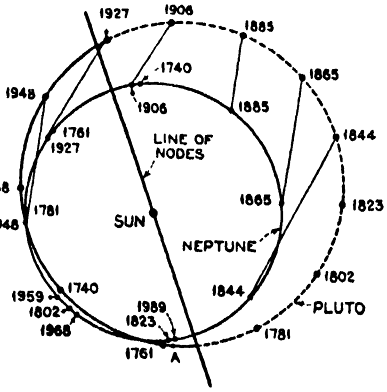


Figure 2: **Neptune's orbit coincides with the plane of the paper, that of Pluto being inclined 17° and intersecting that plane in the "line of nodes." The dotted part is below the paper, the full part above. Thus the orbits are not "grade crossings" and the danger of collision between the bodies vanishes**

Three revolutions of Neptune require 494.3 years. Two of Pluto take 498.3 years. The relative positions of the planets, therefore, almost repeat themselves at intervals of little less than 500 years. Just how they do it can be seen from Figure 2. The positions of Pluto are marked for 12 equidistant intervals, from one perihelion to the next, at intervals of 20.76 years, and also those of Neptune at the same dates. After eight intervals Neptune has completed a circuit of his orbit and advanced a little less than three degrees farther, which explains why the dots representing his positions are arranged in pairs. It appears from the figure that the two planets were nearest in 1892, and that at present Neptune is drawing more and more ahead of Pluto and increasing the distance between them. For more than two centuries the planets will get farther and farther apart, and it will be nearly 500 years before they are as close again as they were recently. "A stern chase is a long chase" and a simple calculation shows that, on the average, Neptune catches up with Pluto once in 486 years, during which interval one planet has made almost three revolutions and the other almost two.

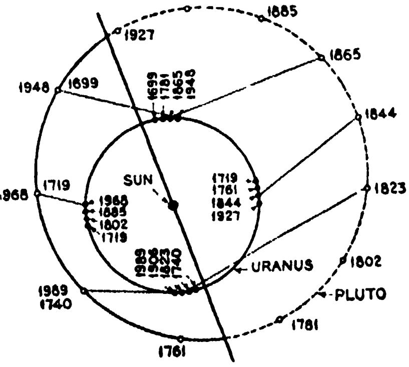


Figure 3: **Relative positions, 1699—1989**

At the recent conjunction, however, the distance of the two planets was 19 astronomical units—more than six times the minimum, and the perturbations, though greater than for centuries past or to come, must have been relatively small. When may we look for a really close conjunction?

A glance at the figure shows that Neptune passed the critical point of its orbit in 1824 and will do so again in 1989, while Pluto reached the corresponding point in 1763 and will do so again in 2012. On the latter occasion Pluto will still have 23 years to go when Neptune reaches the point of approach and, as Figure 2 shows, the planets will be a long way apart. Five centuries earlier Neptune came to the same spot in 1495 and Pluto in 1514, this time only 19 years behind. Working backward in this way we find the conjunctions closer and closer at each interval of five centuries, until in the year 976 B.C. the calculated times for the two planets agree within a few months. Still longer ago Neptune was behind Pluto and the conjunction less close.

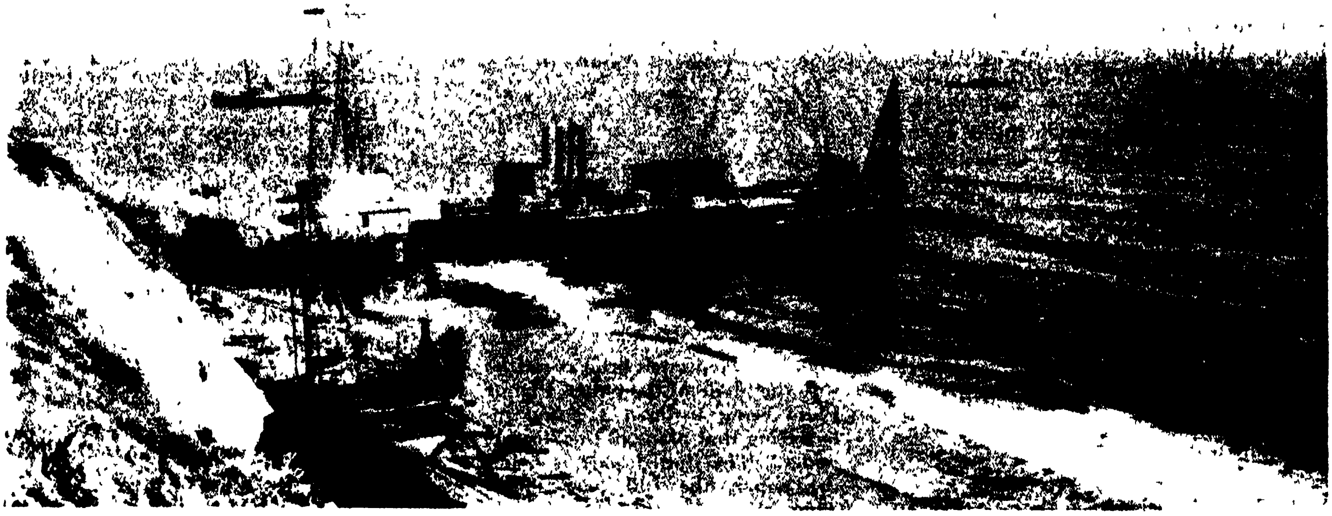
IN the future, the successive "returns" of this conjunction will be less and less favorable but, working forward from 1824 when Pluto was 61 years ahead of Neptune and remembering that the former loses four years in every 494, we find that another close conjunction will occur about the year 9238 A.D. Still others will follow at intervals of about 10,200 years.

These figures, however, are liable to alteration if the true period of Pluto turns out to differ somewhat from that here assumed. If, for example, it were one year longer Pluto would fall behind by six years instead of four in three revolutions of Neptune and the dates of close conjunction would be 11 A.D. and 6765 A.D.; while if Pluto's period should be one year shorter the dates would be near 4000 B.C. and 17,000 A.D. and the interval between close conjunctions fully 20,000 years.

In any case it is clear that no conjunctions of the sort will occur until the span of recorded human history is doubled.

When they do happen the planets are close together for half a century or more, as appears again from a study of the figure. Though the orbital velocity of Pluto is on the average considerably less than that of Neptune, it increases so much at perihelion that for a short time the planet of longer period is actually moving faster and the two bodies

(Please turn to page 487)



Completed derrick on one of the two permits, built as described in the text. The landing wharf, with the steamer *Mahukona* and the tender *Daisy Freeman* in the distance. The derrick barge and the tug *Elwood* may also be seen

OIL FROM BELOW THE OCEAN FLOOR

By C. L. ROBERTS

OIL has been found in burning deserts, waste hills, fever-ridden jungles, cultivated lands where derricks supplant orange groves, and in the frozen steppes of the northland. Under the most favorable conditions drilling for oil is fraught with many difficulties and uncertainties. Consider, then, the problem of sinking a well beneath the ocean bed far from shore; the drilling being attended by legal and physical difficulties which at first glance would appear insurmountable.

The conditions surrounding this latest achievement of oil engineering were tersely described to the contractors, Robinson-Roberts Company of Los Angeles, by the owners of the permit to drill:

"You are to build the foundations for an oil derrick in the Pacific Ocean off shore from the Elwood field, in Santa Barbara County, California. Construction must take care of several things, chiefly prevention of pollution of the ocean by mud, oil, or other waste material; and provision must be made for controlling heavy gas pressure.

"The beach bordering our lease is backed by precipitous cliffs 200 feet or more in height and is so narrow that it is completely submerged at high tide. All shore land above the high-tide line is controlled by our opposition who are patrolling it with armed guards with orders to arrest trespassers.

"Last, but not least, you have just three months to complete the contract and 'spud in' the well or we will lose our permit."

Investigation disclosed that under a recent California law, drilling permits were being granted on state-controlled tide lands along the coast line. Preference was given to littoral owners but through a slip of some sort the permit in this instance had been given to a company that did not have shore lands and wells in this vicinity. The littoral owners sought to block the permitees and keep them from drilling within the time limit specified, hoping thus to compel the permit to lapse, when they would be in a position to apply for a new drilling right themselves.

THE prize at stake was an untold amount of high gravity oil, the type of crude which is the life blood of the industry. It has a high gasoline content and its discovery always is followed by a stampede.

Faced with this problem the contractors were required to pioneer, using methods of construction never tried before, and meeting conditions, the effect of which could not be foretold. Illustrative of this was the first question presented—that of wharf construction leading from the beach to the site of the derrick foundations. It was discovered that the ocean floor was a shale bed with no sand covering. This eliminated the possibility of using round wooden piling, but something had to be found that could be driven into this foundation and still have the structural qualities of the wooden piling.

Decision fell on steel, and what is known as the "H" column was selected. This type of piling has since been found to have the double virtue of being able to penetrate the shale and to resist by sheer weight the flotation action of the ocean.

The anchoring of the derrick, which on land is done with guy wires, was the next problem. It was solved by designing a foundation consisting of five concrete-filled cofferdams. Four of these were placed at the corners of a square and upon these the legs of the derrick were to rest. The fifth, larger than the others, was in the center and was to support the drilling machinery. Here also the question of pollution was disposed of. Under the permit any fouling of the ocean waters meant the loss of drilling rights. This central cofferdam was hollowed out and a steel diaphragm connecting with the four foundations was so constructed that it sloped toward the center, thus catching oil drippings from the machinery, mud from the well, and things of like nature.

However, the two greatest problems were yet to be solved. The first meant working out new methods of construction where all contact with shore was cut off; and the second, obtaining an adequate supply of water for machinery and men.

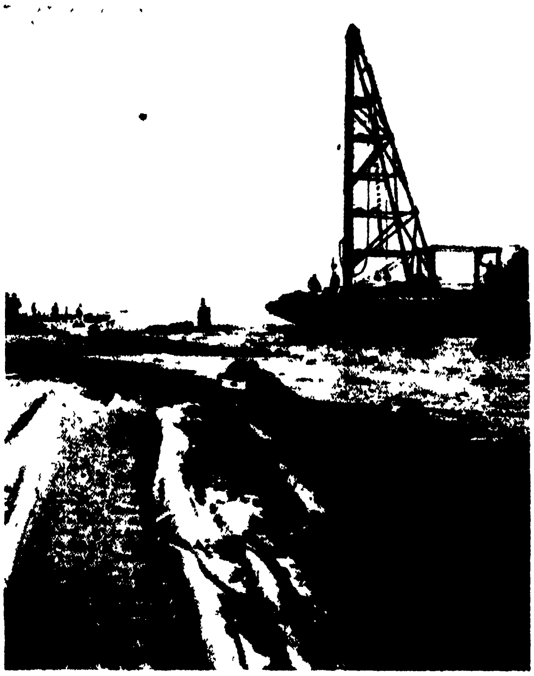
Purchase of the steamer *Mahukona*, a wartime vessel, and her outfitting to carry supplies enough for the job and to house the workers, was decided upon as the answer to the first of these questions. On June 5 the steamer was placed in drydock in San Francisco and 10 days later she dropped anchor off Elwood. In the meantime she had been converted into a floating hotel and warehouse. Every available space was utilized, and a boat with quarters for a normal crew of 25 now housed 150 men, while every article necessary to the construction of wharf and derrick was stored aboard.

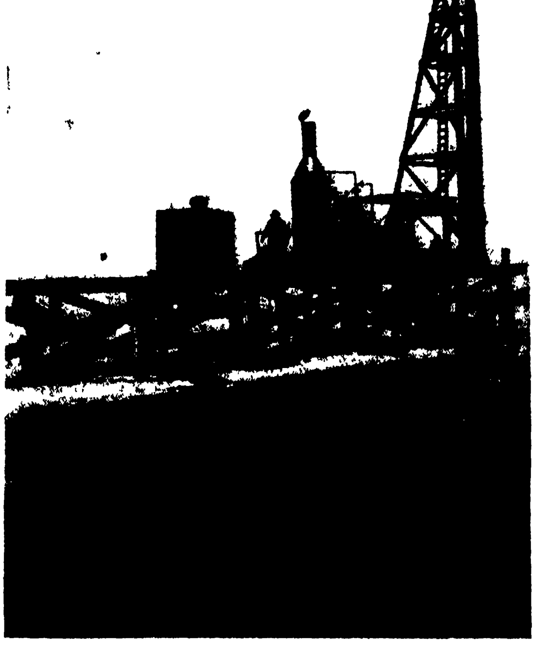
A WORD as to life on that ship will be apropos here, as it is indicative of the difficulties encountered. Anchored within sight of shore, its passengers were unable to set foot on land for diversion or entertainment. Every man was keyed up to high tension, working against time in the effort to complete the contract successfully. Three shifts of men ate, slept, and took their leisure hours in this restricted area so that one man's breakfast was another's lunch and the third's dinner. Men were sleeping, lounging about, or working, according to their employment hours. Beds were made and slept in, only to be remade immediately to make way for the next crew of sleepers. Meals were prepared in a galley eight feet by eight feet and the stove never got cold, for as soon as one meal had been served, the cook began preparation of the next.

With anchorage moorings prepared for the steamer, a derrick barge, two lighters, and two small launches, the actual work of attacking the first construction began. It was determined to build a small wharf on the beach to keep the machinery above high water. A load of short steel piles was sent ashore, through the surf in a skiff. Then the fun began, for it was some time before it was found that, to row a boat ashore through the breakers, we had to turn around and back her in. To this maneuver, sea authorities do not agree, even such a one as Richard H. Dana in his "Two Years Before the Mast," but it proved correct for us. It took several upsets before the lesson was learned but after that we always kept the bow seaward and thus escaped wettings.

THE short steel beams were placed upright in the sand by hand and a platform rigged on these posts. A water tank was floated ashore and rolled up on the small wharf Then the barge came in with water tanks aboard and a man was sent through the surf with a hose-line, and a supply of fresh water was pumped into the big tank. Oil drums were floated in, salvaged on the beach, and rolled up onto the platform. Next a Caterpillar tractor, equipped with a winch, was sent along the beach at low tide, walked onto the wharf, and the shore start had been made.

It was necessary to get a pile driver on shore to begin constructing the permanent pier. A driver had been built on one of the barges by use of the derrick-barge and ships' gear. It was found that low tides occurred at night and highwater at noon. The plan was to beach this barge at high tide, and float it again at some subsequent high tide. Such a procedure would be risky due to the nature of the ocean bed which was cut up with finlike reefs. To strike one of these would mean days of costly delay.


Beaching the barge which carried the pile driver. Her hoisting engine pulled her in


The pile driver on falsework in the surf after it was landed from the beached barge, ready to begin work

An anchor was run ashore and sunk in the beach. This was attached to the bow of the barge to hold her on her course, while port and starboard anchors, which had been placed a short distance from shore, were attached to her stern, their lines run to the drums of the driver's hoisting engine. A stern anchor held the aft end in line. With the engine started, the forward line was taken in and the aft lines paid out, thus hauling the barge onto the beach through the surf.

Once grounded, all lines were made fast. Then a wire cable was attached to the driver and run to the winch of the tractor. The tautness of this cable minimized the surging back and forth in the surf.

WITH carbide flares providing light for night work, with no rest for the men, and with every available hand on the job, a race began to get sufficient piling driven so that the driver could be pulled clear of the barge before the next high tide Men worked in water to their waists. Any tools that were dropped were left as there was no such thing as groping about in the sea to recover lost articles. Hours of high speed work passed with no thought of rest, but the next high tide saw the pile-driver pulled clear and the barge re-floated. The first real battle had been won.

The abnormally high tide that had favored work with the barge and driver, brought disaster to the temporary wharf, which collapsed, throwing the fresh-water tank into the sea. The water was so polluted with salt that it could not be used in the boilers and thus the problem of fresh water became acute.

Water consumption for men, ship,

and job was about 25 tons a day. The capacity of the *Mahukona* was 500 tons, of which 375 were in the "wing tanks," triangular in shape and running fore and aft along both sides of the vessel. Unless the ship were heavily loaded, these could not be filled, or the boat would capsize. The nearest water supply was at San Pedro, 125 miles away with a cost of 300 dollars for a tow from that port. In addition the only water-barge available had a capacity of 90 tons which meant a towing expenditure every third or fourth day. The solution came with the chartering of the steamer *Daisy Freeman* which was used as a water carrier and for lumber storage.

ALL did not run smoothly on the job. What with water, tides, fog, crowded quarters, foaming boilers, and loss of carbide flares and tools overboard, there were plenty of problems that had to be met as they came up. The gasoline launch began slipping its clutch owing to the propeller being fouled in the kelp. A tug was chartered to replace it. This boat was caught in a surge, its tailshaft was twisted off, and it went ashore. The barge used to beach the first driver, and later used for a second driver which began work on another permit covered by the drilling operations, got adrift and struck a reef. Here was a tug ashore and a barge hung up on a reef. Troubles never came singly but seemed to pile up all at once.

The tug was pulled off but this left us with men ashore and no means of conveyance to the mother ship. A fishing boat, skippered by an Italian who could not understand English, was hired, thus affording temporary relief, but the menace of the barge remained. Derelicts have a way of wandering at inopportune times and there was the danger that the barge would suddenly float and go crashing through the falsework, which would be such a serious setback in time that the contract would be lost. And float it did, at 3 o'clock one morning. Luckily, it cleared the workings and was blown up by dynamite to prevent it from endangering our construction work further.

Far out beyond low tide level—one of the completed oil derricks

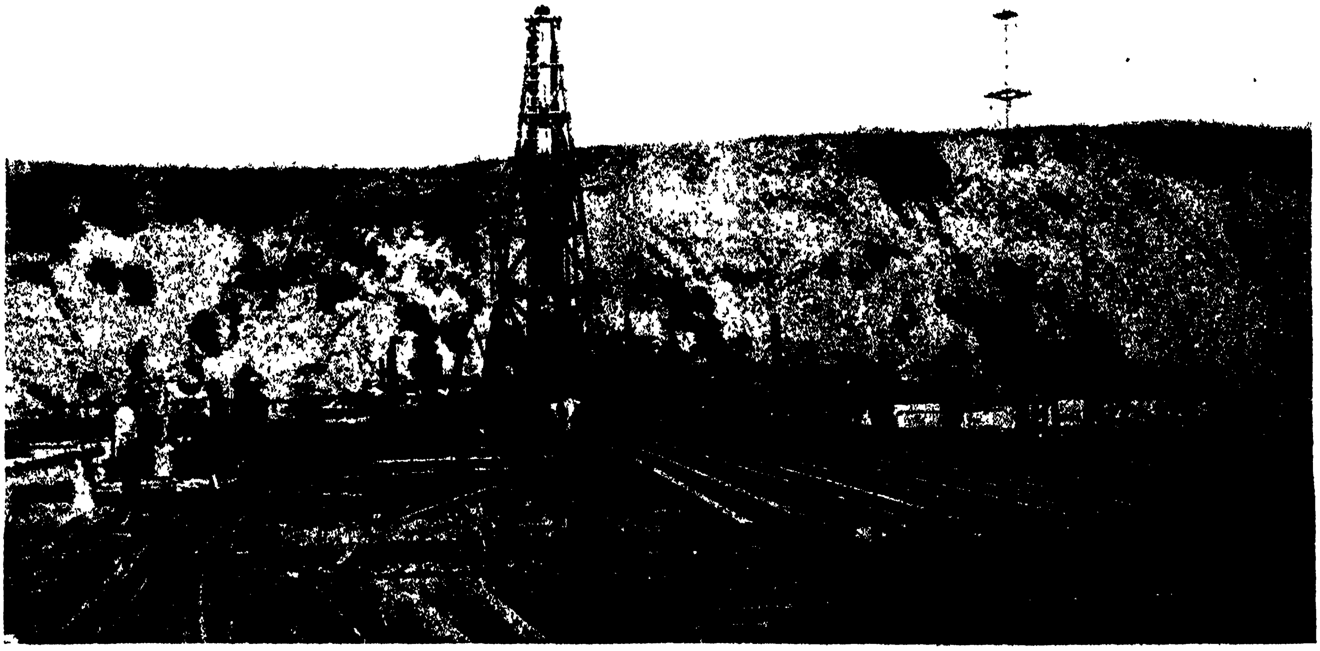
With work well started on the second permit, both jobs swung along at a good clip. Most of the material used was floated ashore and for over a month there was not a man on the job who was not wet from head to foot every hour of the working day. The genial steward, asking one of the men if there was anything dry on him, received the laconic answer: "Yeah, my hat." Yet, despite such handicaps, we progressed.

WITH the falsework driven seaward to the end of the dock, the pile driver headed ashore and took up the work of driving steel piling. The derrick barge was brought into play, being anchored in the surf. Her 100-foot boom swung load after load from the barge to the wharf and despite the lifting of the surf, which increased the arc of the boom, only one sling-load was lost overboard.

By this time divers were employed to retrieve tools and materials that might fall from the wharf or from the cofferdams where the work of erecting the steel derrick was under way.

It was on August 10, less than two months from the time the *Mahukona* had set sail from San Francisco, that the first dock was ready, derrick erected and everything prepared for the spudding in. The second dock was completed 10 days later. The labor and effort this cost and the trying conditions under which it was accomplished beggar description. The joint cost was approximately 400,000 dollars.

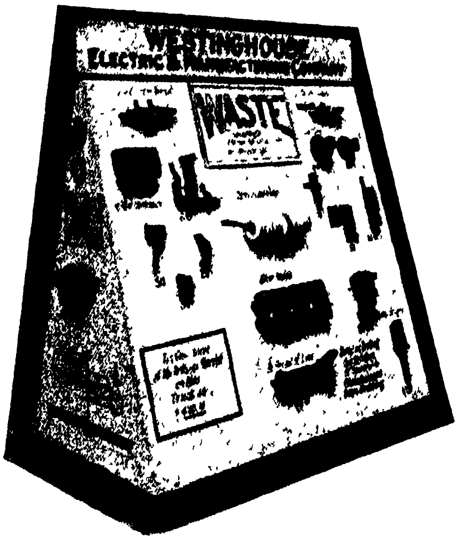
Achievement brought a two-fold satisfaction. Pioneering methods in oil drilling had proved successful, obstacles that seemed insurmountable had been overcome, and oil in good flow was struck without further trouble.


One of the steel wharves under construction. Heavy steel and timber work were necessary. This view shows the character of the cliffs above the work and a producing well on the mesa above the beach. The pile driver is driving the "H" beams

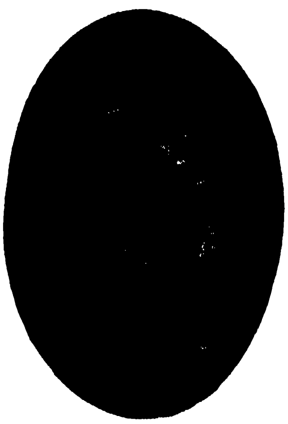
Reclaiming used files by the steam sand-blast method. Approximately 15,000 files a month are reclaimed at the East Pittsburgh plant alone

Above: A cable skinning machine removing the covering from a copper cable so that the metal can be used over again. Formerly, damaged wire became worthless scrap

Used carbon paper can be rejuvenated three or four times by passing over an electrically heated cylinder. The saving is worth while



The portable exhibit is shown all over the plants and is one of many such presentations carried around on trucks



Feet can be welded on discarded calcium carbide containers and so make perfectly good waste cans for the shops. Why buy new waste cans?

Right: Short ends of material make a real waste problem. This electrical butt-welding set makes "big ones out of little ones." The scrap pile is cut down still more

FACTORY WASTES TURNED TO PROFITS

INDUSTRIALISTS have long been worried by two problems which are always present. One is safety and the other is waste. Some of the factory wastes are unavoidable, but there are others that a little care will prevent, particularly with commonplace items which are often overlooked on account of their apparent insignificance. Competition, especially in the form of foreign made goods produced by cheap labor, is steadily becoming keener and if we want to hold our premier position by producing, as we have done in the past, at costs that will allow us to compete, we must eliminate the demon waste. Manufacturers are co-operating with the great engineering societies to bring this home to the employees by posters, actual examples of waste, and by a clever system of rewards for suggestions. The results of the campaign for waste prevention are far-reaching. The Oakland Motor Car Company saved 542,000 dollars in about a year as a result of suggestions. We illustrate some of the things done at the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

SCATTERED LIGHT AND THE RAMAN EFFECT

By **R. W. WOOD, LL.D.**
Foreign Member of the Royal Society
Professor of Experimental Physics at Johns Hopkins University
Contributing Editor, *Scientific American*

IF we are sitting in a darkened room and a beam of sunlight filters in through a chink in the shutters, it is a matter of common observation that the beam is itself invisible from the side, unless there is smoke or fine dust particles in the air. But when a whistle blast enters a room through a hole in the wall, the waves spread out, filling the entire room uniformly, and the ear hears the sound in one place as well as in another. We may explain this action of sound by considering the vibrating air, in the aperture in the wall, as itself a source of sound, which sends out waves uniformly in all directions.

This difference in the behavior of light and sound we express by saying that light is propagated rectilinearly or in straight lines, while sound is not, and it was precisely this difference in behavior that was raised as an objection to the wave theory of light when it was first stated in definite form by Huygens in 1678. The difficulty was cleared up by Fresnel who proved mathematically that, in the case of the extremely short waves of light, rectilinear propagation and the formation of shadows were due to interference. In other words we may consider that secondary waves of light start out laterally from every point on the beam of sunlight, just as we considered the sound as radiating from the aperture, but if we calculate their combined effects at any point outside of the beam, the resultant is zero, or complete darkness.

WE need not go into the proof of this, but it can be shown mathematically that, at all points within the shadow, radiations from any point in the illuminated region are destroyed by other radiations from some other point, the two sets of disturbances arriving half a wavelength apart and destroying each other. This is known as the Fresnel-Huygens principle.

Very high pitched sounds behave somewhat like light, evidence of "shadows" frequently being observed, while in the case of the very high frequency waves from vibrating quartz plates, such as were employed by Langevin for submarine signaling (see article "Sounds that Burn," SCIENTIFIC AMERICAN, March 1928) the "sound" can be projected through the water to a great distance, like the beam of a search light. Here the Fresnel-Huygens principle operates to destroy the spread in lateral directions. If any material particles, such as minute specks of dust, are suspended in the air traversed by the beam of light, each particle scatters light into the shadow, and if very small indeed, the particles scatter blue light more powerfully than red or yellow. In other words the light diverted into the region of shadow is rich in radiation at the short wavelength end of the spectrum. The selective scattering of blue light can be seen by holding a lighted cigarette or cigar in a beam of sunlight, and viewing the smoke against a dark background. In general there will be several filaments of smoke rising, some white, in which the particles are comparatively large, and some blue in which they are smaller.

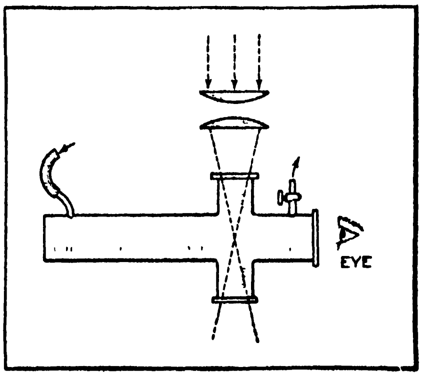


Figure 1

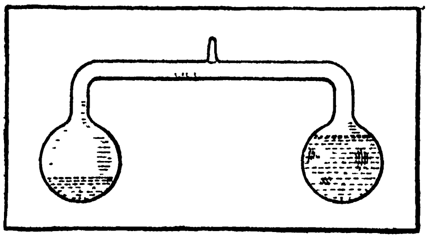


Figure 2

The blue color of the sky was formerly thought to be due to a similar scattering of light by very small dust particles suspended in the air of the upper atmosphere, but Lord Rayleigh's calculations indicated that the scattering in this case was due to the actual molecules of air. Many years elapsed before this scattering of light by pure dust-free gases was detected in the laboratory by Lord Rayleigh's son (the present Lord Rayleigh) and independently and at about the same time by Cabannes, a French physicist. Sunlight was focused by a lens at the center of a black tube, through a window in the wall, and a very blue cone of luminosity was observed through a glass window in the end of the tube, which was filled with air filtered through cotton-wool to remove dust particles (Figure 1).

SIMILAR results were obtained with other pure gases, even with hydrogen, the scattering power of which was many times less than that of air, while that of ether vapor was much greater. Some experiments were made by the writer at East Hampton, New York, with a view of comparing the intensity of the light of the blue sky with the intensity scattered in the laboratory by dust-free air. Sunlight was concentrated by a "reading-glass" lens six inches in diameter, at the center of a black tube, similar to that of Lord Rayleigh, and the blue cone seen in the tube was matched against a bit of blue sky reflected in a small mirror of black glass, which reflects 4 percent, through a very narrow slit in the rim of a large disk of black cardboard, rotating at high velocity in a dark room. In this way the intensity of the sky light was reduced to that shown in the tube. The total amount of air directly above us is the equivalent of an ocean of air of uniform density at atmospheric pressure five miles deep. This thickness of air, illuminated by normal sunlight, forms the blue sky. In the laboratory the layer illuminated was less than one eighth of an inch in thickness but the illumination at the focus of the lens was about 1400 times that of normal sunlight. The two could be matched by making the slit in the disk sufficiently narrow, and calculations showed that the blue sky could be fully accounted for by molecular scattering of light by the air.

A similar scattering was observed in pure distilled water, freed from suspended motes by repeated distillation *in vacuo* without ebulition in a double bulb, as shown in Figure 2. The bulb containing the liquid should be heated to only 15 or 20 degrees above room temperature, or one bulb may be immersed in ice and the other kept at room temperature. After about one quarter of the liquid has passed over, this is shaken about in the bulb and then poured back into the other bulb, carrying with it any motes which may have adhered to the walls. After two or three repetitions of this process, nearly the whole of the liquid is distilled over, and it will now be found to be "optically clean"; that is, it will show no bright specks when sunlight is focused at the center, but only the pale blue cone of light scattered by the water molecules. It must be viewed against a black background.

NOW a very striking thing is shown in the case of scattering by a liquid and its vapor. We might very reasonably expect the scattering of the light to be proportional to the number of molecules present, and as there are roughly 1000 times as many molecules in a given volume of liquid as in an equal volume of its vapor at atmospheric pressure, we might look for an intensity 1000 times as great in the liquid as in the vapor. As a matter of fact we observe an intensity less than 50 times that of the vapor.

This is, however, precisely in accord with the theory, for in the liquid we have a nearer approach to a continuous medium and if the medium were perfectly continuous and structureless there could be no scattering, for in this case the secondary waves would destroy each other, just as they do when no material medium at all is present and they originate in the vibrating "ether," the hypothetical "medium," the vibrations of which constitute light.

This means that, in the case of the liquid, "interference" is taking place between the scattered radiations, and the lateral diffusion of light by the molecules is partially prevented. Transparent crystals, such as quartz, scatter still less light since the molecules are arranged in a perfectly regular manner on a so-called "lattice," and this condition approaches the condition of a continuous medium from a mathematical standpoint; at all events there are no variations in density from point to point such as occur in a liquid as a result of thermic agitation or the to-and-fro oscillation of the molecules which constitutes heat.

The absence of scattering in the case of a crystal lattice can be beautifully shown with a thin flake of mica. Both surfaces should be freshly cleaved, which can be most easily accomplished by rubbing the edge of a thin plate with the side of a needle until it is flattened, and then inserting the point between the layers of the mica. If a flake prepared in this way is attached to the edge of a carefully cleaned cover-glass, such as is used for microscope slides, the strong scattering of the glass, as contrasted with the absence of scattering by the mica, can be shown by focusing sunlight first on one plate and then on the other, viewing them against a dark background. It was formerly supposed that no change of color was produced by the scattering; or, speaking more accurately, no change of wavelength in the case of the blue smoke or blue sky. There is an apparent change of color, to be sure, but the scattered blue light was originally present in the white light, and the color is not produced by a change in the length of the light waves.

In 1923 Smeckal predicted from the modern quantum theory of light that if a medium was powerfully illuminated with monochromatic light—that is, light of a single wavelength, analogous to a pure musical tone—there should be present in the scattered light, faint traces of other monochromatic radiations and that a "spectrum" would be characteristic of the substance illuminated.

FIVE years elapsed before this prediction was verified by Sir C. V. Raman, the distinguished Indian physicist of the University of Calcutta; and at very nearly the same time by Landsberg and Mandelstamm, the former working with various liquids, and the latter with crystalline quartz.

The arrangement used by Raman is shown in Figure 3. The light from a horizontal mercury arc-lamp (through a draftsman's error, a carbon arc is shown) was focused at the center of a spherical flask filled with benzene or any other liquid, and the spectroscope pointed at the illuminated region at the focus. Exposures of many hours were necessary to secure a photograph of the spectrum, owing to the faintness of the light. Numerous bright lines were found in the case of every liquid examined. In the majority of cases the new lines were of longer wavelength than that of the exciting light—that is, they were on the red side of the spectrum lines of the mercury arc, but in the case of some liquids, such as carbon tetrachloride and chloroform, lines of shorter wavelength were found on the violet side of the same lines.

At first sight it might appear as if this was merely a case of fluorescence, but Raman found a remarkable relation between the wavelengths of the new lines and that of the exciting radiation, which is quite different from anything observed in the case of the phenomenon of fluorescence.

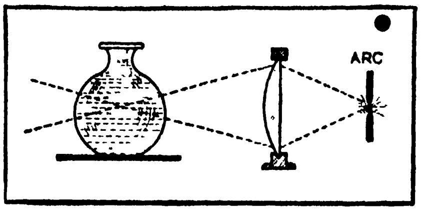


Figure 3

In the first place he found that the arrangement of the spectrum lines in the groups excited by the various mercury radiations was exactly similar. For example, carbon tetrachloride gives a spectrum shown by diagram in Figure 4, the two mercury lines being indicated by arrows. The lines to the left of the mercury lines are of shorter wavelength than that of the exciting line and are called "anti-Stokes lines," being exceptions to a supposed law formulated by Sir George Stokes, that, in the case of fluorescence, only radiations of wavelength longer than that of the exciting light could be emitted. The relative spacing is the same to the right and left of the exciting mercury line except that it is reversed. Secondly, he found a very remarkable relation between these new lines and the absorption bands of the substances in the remote infra-red region of the spectrum. If the frequencies of vibration of the Raman lines are subtracted from the frequency of the exciting light the numbers obtained represent the frequencies of the infrared absorption bands which are found experimentally only with considerable difficulty.

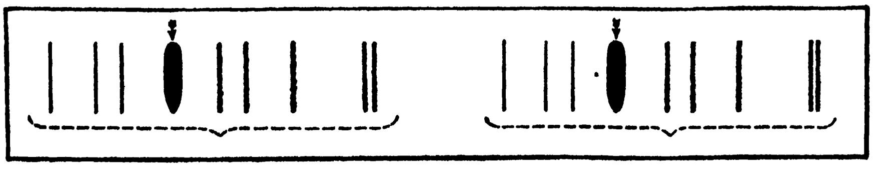


Figure 4

WE thus have a very simple and direct method of investigating the infra-red absorption of substances by means of visible light, and of securing data on the structure of complex molecules. The matter has turned out to be somewhat more complicated than was at first supposed, for not all Raman lines have infra-red absorption bands associated with them, and some infra-red bands are not represented by Raman lines, but the theory is being gradually worked out.

The original and simpler theory, as first given by Raman, explaining the formation of anti-Stokes lines, is as follows: The quantum theory of light regards a beam of monochromatic light, say the green light of the mercury arc, as made up of discreet "packets" of energy, all of the same magnitude, called "light quanta." As the beam diverges in space these quanta merely get farther apart, without suffering any loss of energy. The energy content of a light quantum increases progressively as we pass from the red to the violet and ultra-violet.

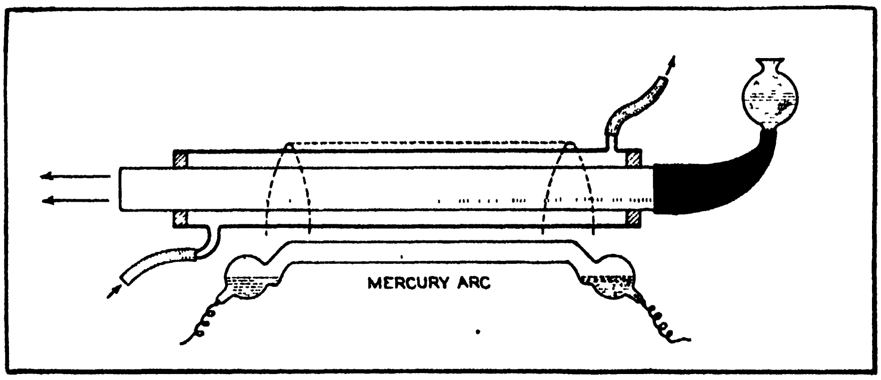


Figure 5

When now one of these quanta enters the benzene, one of three things may happen. It may be diverted from its original direction without loss of energy, giving the line of unmodified wave-length in the Raman spectrum. It may give up some of its energy to a benzene molecule, and emerge from the medium with diminished energy, giving a line on the red side of the exciting line. Or it may abstract a certain definite amount of energy from a molecule already in an excited state—that is, in vibration as a result of temperature—and emerge with increased energy, giving an anti-Stokes line. It is found that the intensity of these anti-Stokes lines increases as the temperature of the medium is raised, as more molecules are then in excited states.

The method of illumination employed by Raman is very inefficient as only a small percentage of the light of the lamp is utilized. The arrangement now universally used is the one described by the writer shortly after Raman's first publication; the liquid under investigation is contained in a glass tube provided at one end with a window of glass fused to the tube, or with a flattened bulb, the other end being drawn off obliquely and painted black. This tube may be surrounded with a second tube in which water circulates to prevent overheating, and the arc is brought up as close to the tube as possible, as shown in the drawing above (Figure 5).

A HALF cylinder of polished aluminum placed over the tubes still further augments the illumination. The scattered light is photographed with a spectroscope pointed down the tube toward the black cone at the farther end. A still further improvement is to use a large glass tube filled with an absorbing liquid which cuts out the light of all but one of the mercury lines, and, acting as a cylindrical lens at the same time, focuses the light on the tube containing the liquid. In this way it is possible to photograph the stronger Raman lines in a few minutes.

A helium "vapor lamp" has also been used by the writer for the excitation of Raman spectra. With a special filter, consisting of a tube of glass colored black with nickel oxide, which surrounded a tube filled with benzene, both being mounted beside the arc and completely surrounded by a cylinder of highly polished sheet aluminum, the Raman spectrum excited by the strong ultra-violet helium line 3888 was obtained.

Three spectra of benzene are reproduced in Figure 6, the upper two by the mercury, and the lower by the helium, arc. They are reproduced as "negatives"; that is, the bright spectrum lines come out dark. The upper one was made with the mercury arc light filtered through a tube containing a saturated solution of a salt of praseodynium, which absorbs the continuous spectrum of the arc in the region where the Raman lines appear and permits the fainter lines to record themselves. The excitation in this case is by the triple mercury line 4358 at the left, and also by 4046 and 4077, which lie still farther to the left and do not appear. The black area at the extreme left is the (over exposed) image of the light of the 4358 triple line scattered without change of wavelength with an intensity of about 500 times that of the strongest Raman line. Lines numbered 1 to 6 inclusive, are excited by 4358, and lines *a* and *b* by 4046 and 4077, *a* and *b* being the same Raman line as 6 by the other excitation. The two lines to the left of 3 are identical with 3, being excited by the two faint companions of 4358, shown as double arrows above the spectrum. Two other fainter mercury lines show to the left of 6. Line 5 is double.

The middle spectrum was made with a quinine filter, which absorbed 4046-4077, and lines *a* and *b* are absent.

The lower spectrum was taken with helium excitation, and is the simplest of the three, as the exciting line 3888 is single. Two faint helium lines have been marked out by covering over on the print.

These are probably the best Raman spectrum photographs that have been made up to the present. Raman spectra have also been made of gases at atmospheric pressure by Rasetti, the writer, and others.

THE first gas studied was hydrochloric acid, contained in a large glass tube about six feet in length mounted in contact with a Cooper Hewitt mercury arc of the same dimensions, the two being surrounded by a hollow cylinder of polished aluminum. The light of the arc, imprisoned by this reflector, was beaten back and forth through the gas tube, securing the maximum intensity of illumination. The spectroscope was pointed so as to "look down" the entire length of the gas tube through a bulb of thin glass blown on the end. With an exposure of only 24 hours a strong Raman line was obtained which was shown by calculation to be associated with the infra-red absorption band of the gas, previously discovered, while the exciting mercury line, scattered without change of wavelength, was bordered on each side by regularly spaced lines which can be shown to be the result of rotation of the hydrochloric acid molecules.

This very important discovery by Professor Raman is opening up a wide field of investigation and throwing new light upon the theory of molecular structure.

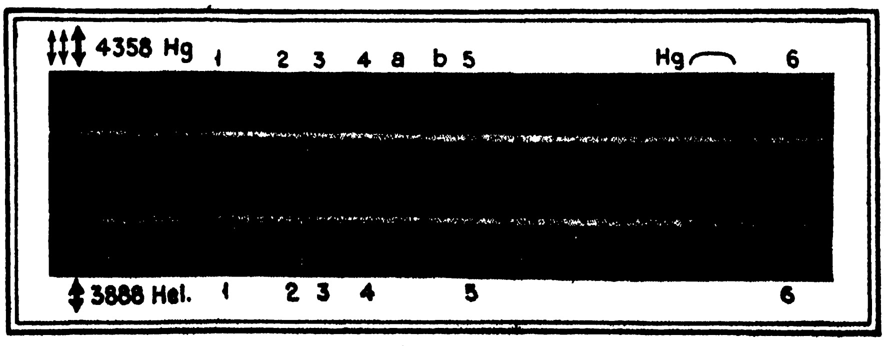


Figure 6

AN ATOM OF LUTECIUM

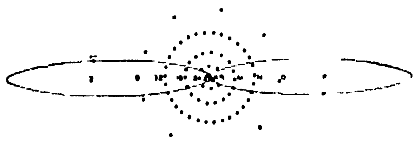
By NELL RAY CLARKE

FOR the first time the atomic structure of an atom of lutecium has been plotted, this having been accomplished by Dr. William F. Meggers of the Bureau of Standards. The arrangement of the electrons in an atom of lutecium as plotted by Dr. Meggers suggests the nose and wings of an airplane with a radial engine. To Dr. Meggers the arrangement of dots mathematically spaced gave a great deal of satisfaction. He said, "The thrill and satisfaction derived from this discovery may be compared with that accompanying the discovery of the ninth planet of our solar system. Indeed, the lutecium atom is pictured as a solar system with a nucleus, corresponding to the sun, surrounded by electrons which correspond to the planets. However, instead of merely nine major planets which are known to belong to the solar system, the lutecium atom has 71 planetary electrons."

FOR years Dr. Meggers has been working over the riddle presented by the group of elements known as the "rare earths," about which little or nothing is known. The mere names of these elements present for the layman as well as the scientist, perhaps, the most formidable array of unpronounceable words to be found in the English language. Try them out on yourself, if you don't believe it. Here they are—cerium, praesodymium, neodymium, illinium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutecium.

It is only within comparatively recent years that these elements have been isolated; lutecium was isolated in 1907 by the French chemist Urbain. They are for the most part very rare, and although a few of the more common ones have found commercial uses, the rest may be regarded at present as interesting chemical curiosities. They form a unique series of elements, with chemical and physical properties so closely similar that it is exceedingly difficult and laborious to separate them from one another.

A few years ago, the Bureau of Standards purchased for experimental purposes a tiny tube of lutecium oxide from the Welsbach Laboratories in Vienna, almost the only place in the world where it is available. Up to that time, no one had ever worked out the structure of the atoms of a single one of these rare earths. But Dr. Meggers decided to try it, following the lines of the Bohr theory. This had often been attempted before, but Dr. Meggers and his assistant, Mr. Bourbon Scribner, are the first to succeed.



Bohr model of lutecium atom. Orbits of two of the 71 electrons are shown. Diameter of atom is approximately one 50,000,000 inch

According to Bohr's theory, the atoms, or smallest units of the different chemical elements, are conceived as being built up of positive and negative units of electrical charge, called protons and electrons, respectively. Beginning with hydrogen, which consists of one proton and one electron, the successive addition of protons and electrons explains the structure of heavier and more complex atoms, until the end of the list is reached with uranium which has 92 outer electrons.

First Dr. Meggers had to get the spectrum of lutecium. To do this he impaled some of the lutecium oxide on a piece of wire and passed a current of 220 volts through it to get the spectrum of the neutral atoms. Then by exciting the spark to 40,000 volts he was able to remove one of the electrons from the atom, which gave the lines of the spectrum from the atoms of lutecium with one electron off. Later he got the lines of lutecium with two electrons off; these are in the ultra-violet end of the spectrum and therefore are not visible to the eye though they affect a photographic plate as does visible light.

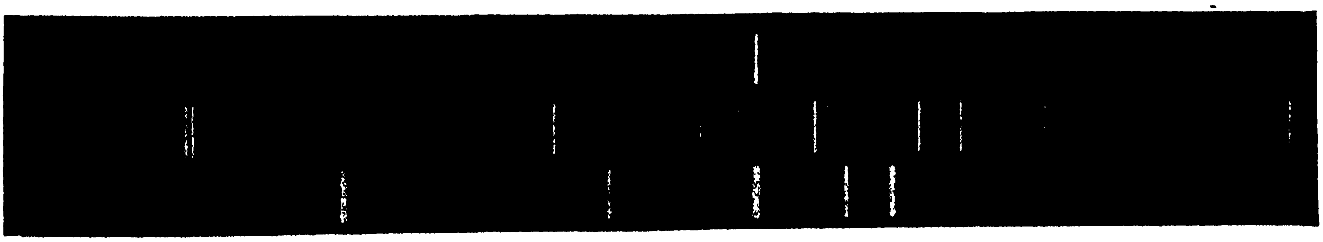
He found that there are 200 lines in the spectrum of neutral lutecium and 450 lines in the spectrum of lutecium atoms lacking one electron. The illustration shows only a few inches of the spectrum; the whole spectrum measures from eight to ten feet in length. The position of each of the lines relative to known wave-lengths in the iron spectrum was measured—a task almost incomprehensible to the layman because of the infinite pains it required.

THE results of the calculations which revealed the regularities among spectrum lines and disclosed the structure of the atom he set down in tiny figures arranged in neat rows. There were enough of them to cover a sheet of paper as large as two card table tops. The graphs he drew to illustrate and explain his work are more complicated than the geometrical designs President Hoover draws during his interviews or while telephoning.

By studying these results Dr. Meggers obtained the solution of the problem of just the exact position of each electron in the atom of lutecium. He is now working upon calculations which will enable him to plot the atomic structure of some of the other rare earths. The spectra of ytterbium, the one being studied at the present time, will be more complicated than those of lutecium, but the atomic structure will be some integral part of the atomic structure of lutecium.

●

A Mexican savant believes he has succeeded in creating living substance, protoplasm, from chemicals. In an early number an account of his intriguing experiments will be described. —The Editor.



A portion of the spectrum of lutecium. The top spectrum is of the neutral atoms; the middle one is an iron spectrum ("comparison spectrum"); and the bottom is the spectrum of lutecium with one of the planetary electrons removed

SCIENTIFIC CRIMINOLOGY—THE PISTOL WITNESS

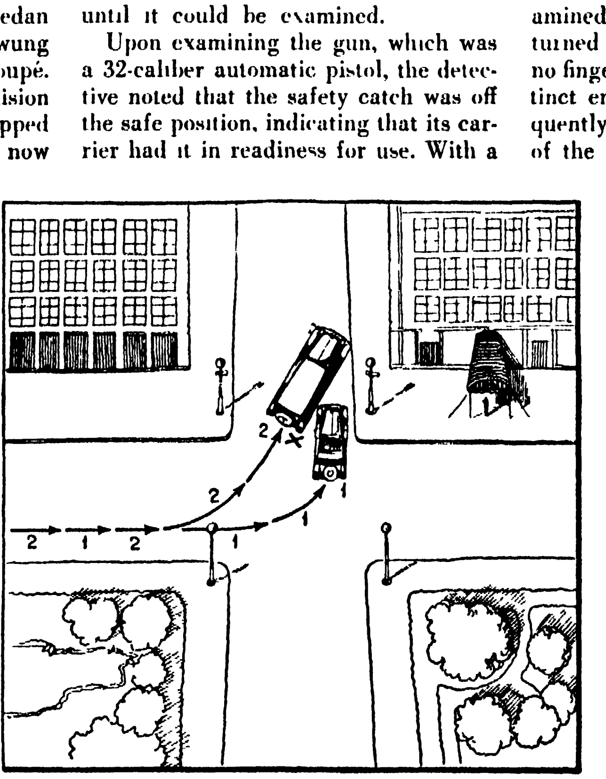
By STANLEY F. GORMAN

Lecturer on Bullet and Firearm Identification, Police College, City of New York

AS a fitting sequel to his article in our October issue, Mr. Gorman has set forth in these pages an actual case taken from the New York police records, in which it is shown how the study of firearms and ammunition is applied in every-day police work. He makes no pretense of telling a mystery story; he gives a bald statement of fact.—*The Editor.*

WITH the roar of hard pressed engines, a heavy sedan and a powerful coupé whirled around the corner racing side by side. The sedan suddenly spurted ahead and swung diagonally across in front of the coupé. With a screeching of brakes a collision was avoided and the two cars stopped close to the curb. From the coupé, now in the rear, leaped a man with a gun in his hand. The left-hand door of the sedan opened and a second man, also with a gun in his hand, stepped forth. Shots were fired and a man was seen to leap back into the coupé, back away from the sedan, and speed away from the scene.

THE exact details of what occurred at this recent homicide in New York were beclouded by different versions rendered by different witnesses. According to some, the man in the sedan started to get out the left-hand door, hesitated, and then got out the right side. Others say that he emerged from the left-hand door. In any event, when the police arrived on the scene, the driver of the sedan was found crumpled in a heap directly behind the right-hand rear wheel of his car. It then remained for the police and detectives to make a thorough examination of the scene and from the facts obtainable from witnesses and clues, deduce the facts and bring the murderer to justice.



Scene of the deed. The cars are shown in their relative positions at the time of the fatal shooting

When the detective arrived on the scene of the crime he found that the driver of the sedan had been removed to the hospital as he was still alive and there were possibilities of saving his life. It developed, however, that shortly after entering the hospital he died. There was a group of about a hundred people surrounding the sedan and held back by the police in charge of a sergeant. The detective found upon questioning the police that the pistol which had been dropped by the driver of the sedan when he was wounded had been carefully picked up by the sergeant. This was done with a pair of pliers in order not to destroy any possible fingerprints. The weapon was placed on the floor of the sedan in the rear compartment so that it would be undisturbed until it could be examined.

Upon examining the gun, which was a 32-caliber automatic pistol, the detective noted that the safety catch was off the safe position, indicating that its carrier had it in readiness for use. With a screw driver the detective pushed the catch to the safe position and picked up the pistol, handling it by means of the screw driver placed through the trigger guard. He then examined it as carefully as possible under the circumstances and looked into the muzzle for powder smudges. He also smelled it for the odor of powder in an endeavor to determine whether or not the gun had recently been fired. It must be remembered that he could not determine whether or not the gun was loaded as this had to be done after the search for fingerprints was made; handling might destroy fingerprints which could be used as evidence. As far as the detective could determine, the weapon had not been discharged, for the barrel contained neither powder smudge nor discoloration and had no burned-powder odor. Furthermore, it was apparently quite wet with oil.

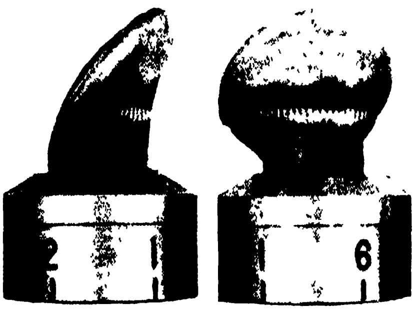
The firearm was then handed to the fingerprint expert who dusted one side carefully with white clay powder and examined the surface. The gun was then turned over and the other side dusted but no fingerprints were found that were distinct enough to be classified. This frequently is the case with pistols because of the difficulty of obtaining a distinct fingerprint on the checked surface of the grip. After the fingerprint examination it was possible to determine whether or not the pistol was loaded. The magazine was found to contain five 32-caliber cartridges, and a sixth cartridge was in the chamber. These cartridges, as well as the interior of the weapon, were covered with oil and an examination of the barrel confirmed the first-formed opinion that the gun had not been fired.

TO return to the scene of the crime: The detective asked for any empty shells found nearby. The police had picked up a 25-caliber shell immediately behind the sedan but this did not completely satisfy the detective. He had been told by witnesses that four shots had been fired and since an automatic pistol ejects its shells immediately as each one is fired, there must be other shells in the vicinity. A careful search soon disclosed three more empty 25-caliber shells.

The next thing to attract the detective's attention was a back cushion, such as drivers frequently use, lying on the running board. Upon asking where it came from and where it was found he was informed that it was lying in the roadway under the running board immediately below the left front door. Apparently it had been dragged out by the victim when he opened the door to get out of the car. This served in great measure to refute the statement by certain witnesses that the driver of the sedan had left the car by means of the right-hand door. After asking a few more questions, the detective gave orders for measurements to be made of the exact position of the car relative to the curb and the nearby corner. A photographer was instructed to take pictures of the sedan from various positions, and also pictures of the entire block from the corner.

THE detective then went to work to examine the interior of the car for possible bullet holes, commenting upon the fact that, while no 32-caliber shells had been found, it was possible that a shot might have been fired by the driver of the coupé before the man in the sedan got out. His diligence was soon rewarded, for he found a small hole in the cloth lining on the inside of the left front door close to the handle. He carefully cut away the cloth and on tearing the lining he found a metal-patched 25-caliber bullet flattened against the door lock. It had distinct rifling marks and also appeared to have some blood on it when examined under the magnifying glass.

The detective now had in his possession the following knowledge: several conflicting stories told by witnesses; the fact that the back cushion had been found on the roadway under the left running board; the information that four 25-caliber shells had been found on the scene; and that a bullet had been lodged in the left front door of the car. His next procedure was to go to the hospital and examine the body of the driver of the sedan. It was found that a bullet had pierced the left wrist. This wound was accounted for by the bullet which had been found in the door of the car. There were three other wounds on the man's left side and when an autopsy was performed three 25-caliber bullets were removed from the body. Upon microscopic examination of these bullets it was found that each had six land and groove marks (see page 265 October 1930 issue of the SCIENTIFIC AMERICAN), the direction of which ran from left to right. Each bullet also had punched on it a small letter "w" indicating that it was made by the Winchester Repeating Arms Company. This small "w" linked the bullets with the shells which were all stamped with the mark of the same company.


Two views of the mushroomed 25-caliber bullet taken from the car

While all this work was going on and the police were busily engaged in building up a case, the driver of the coupé, fearing possible capture by the identification of the car which he drove, consulted with his attorney and decided to surrender himself. This he did, telling an apparently straightforward story of self defense. He claimed that the driver of the sedan had opened fire first, firing two shots at him. The driver of the coupé surrendered both his gun and his automobile. The car bore distinct scratches on the edge of the left-hand mudguard which coincided with scratches on the rear right-hand mudguard of the sedan. The pistol was a Spanish make 25-caliber automatic and was not loaded when surrendered but had powder smudges on the interior of the barrel. Furthermore a strong odor of powder indicated that the pistol had been discharged recently. The gun was turned over to the firearm expert and five test shots were fired into cotton waste. The bullets were recovered and an examination was made under a comparison microscope. It was determined beyond a doubt that the test shots, the three fatal bullets, and the bullet removed from the car door had all been fired from the same gun. (The methods used in reaching this conclusion were dealt with in detail in the October issue of the SCIENTIFIC AMERICAN.) It had already been determined, as described above, that the 32-caliber automatic had not been fired.

The evidence in this case was presented to the Grand Jury and its members were given all the facts determined by the scientific examination of the firearms. They failed to indict the defendant, on the ground that the driver of the sedan had evidently intended to shoot the driver of the coupé and that therefore the latter had acted in self defense. The members of the Grand Jury, however, expressed their interest in the preparation of the case and were deeply impressed by the scientific methods used by the Police Department in determining the facts.

IN order to complete the investigation and mark the case definitely "Closed" it was necessary to establish a motive. It developed that the driver of the coupé, several months prior to the commission of the crime, had delivered a large quantity of grapes to the other party, the value of which was 800 dollars. After repeated attempts to collect this debt, a summons to appear in court was served upon the purchaser of the grapes, who accepted the summons but gave a receipt, as it were, by striking his creditor in the face. The latter's dignity was severely hurt but he decided to use a more effective weapon than his fists. He therefore left as though he was completely defeated but planned a suitable revenge.

He drove directly to his office and took from his desk the 25-caliber automatic pistol. As he re-entered his car he noticed his debtor seated at the wheel of a sedan at a nearby corner. He realized then that he was in for trouble. Suddenly, so it appeared to the man in the coupé, the driver of the other car vanished. This apparent change in the situation reduced the vindictiveness of the driver of the coupé to fear, and he thought it a good opportunity to get away safely He started away from the curb with a burst of speed and as he passed the sedan he saw his opponent straighten up from the seat where he had been hiding. The sedan too started off at great speed and the race ended as has been told. The customer paid the bill in full. It was he who staggered to the rear of the sedan with gun in hand and fell fatally wounded to the pavement.

The prisoners' pen in the photograph gallery at New York police headquarters. *Center:* Fileing out written records. *Extreme left:* Taking a set of fingerprints

The *Charles G. Black*, one of the largest tankers of the Standard Shipping Company's fleet. She has a tonnage of 20,500, and is 550 feet 3 inches long, 72 feet 2 inches beam

WHEN CRUDE OIL CROSSES THE SEAS

By HENRY W. HOUGH

MORE new merchant ships now are under construction throughout the world than at any time in recent years. The present total of 3,265,929 tons exceeds by more than 100,000 tons the level attained just prior to the World War. This notable peace-time revival in one of the world's greatest industries has been even more marked in the United States than in other maritime countries. The tonnage of new vessels under construction in American shipyards still is only about one eighth of that laid down in yards in Great Britain and Ireland, but during the last quarter, the United States advanced from fifth place to third, and now is hard on the heels of Germany, which holds second place in the tonnage of new ships being built.

Amid this quickening interest, particularly notable is the recent impetus in the construction of tank ships. The increase is attributed to the world-wide and ever-increasing demand for petroleum products and other bulk cargoes, such as creosote, molasses, coconut oil, turpentine, whale oil, and vegetable oils. By far the most important of these liquid cargoes is crude oil. Much gasoline, fuel oil, and other refined petroleum products also are transported in "tankers."

Of all the new tankers now under construction in America and abroad, perhaps the most interesting are the two new 18,000 ton ships being built at the Kearny, New Jersey, works of the Federal Shipbuilding and Dry Dock Company. These vessels are being constructed for the Standard Shipping Company, marine subsidiary of the Standard Oil Company of New Jersey, which owns and operates the world's largest tanker fleet. With the additional ships now being built, this great fleet will comprise 106 ships aggregating 1,105,528 tons, operating in all parts of the world but especially in American inter-coastal traffic.

The two new Standard tankers are said to represent the "last word" in design and equipment, and are expected to show a substantial saving in operating costs as well as in the initial investment. Their construction is being watched with interest by those interested in ships of this kind, because of a number of departures from standard design which are being incorporated.

THEY are 544 feet in length, 74 feet in width, and 40 feet in depth, with a draft, when loaded, of about 28 feet. They are single-screw ships, and will operate at an approximate speed of 11 knots per hour when loaded to capacity. Both are being powered with De Laval cross-compound steam turbines equipped with double-reduction gears of recently improved design, made by the same manufacturer.

Oil-fired Babcock and Wilcox water-tube boilers will supply the turbines with superheated steam under 400 pounds pressure at 750 degrees, Fahrenheit, at the superheater outlet. All of the ship's auxiliary equipment will be operated electrically, including the cargo pumps and steering gear. Two 300-kilowatt turbo-generators will provide the electricity. These power plants follow the practice which has proved most satisfactory on land in central power station service, with turbines operated by steam at high pressures and high temperatures and the auxiliaries operated by electricity.

Perhaps the most interesting of the new features incorporated in these tankers is the revised arrangement of the boilers. Instead of placing the boilers in front of the turbines, as is the customary practice, they are located aft in the narrower part of the stern. The additional space made available by the new arrangement is of exceptional value in ships of this type, because of the tankers' characteristic location of the propulsive equipment in the stern, where the curving hull reduces the available space required for the various auxiliaries of the engine room.

In addition to increasing the space in the engine and boiler rooms, this arrangement permits the use of a flexible propeller shaft nearly three times the conventional length. A high degree of flexibility between the turbine and the propeller shaft is considered one of the paramount characteristics of an efficient marine power plant.

These new tankers are being equipped with the already famous "contra-rudder" and "contra-propeller." By using these stream-lined propeller hubs, stern-posts, and partially balanced rudders, an appreciable saving in fuel costs will be effected. At the former fuel consumption, the speed of ships is increased from 5 to 10 percent with this equipment. In addition, there is a reduction in torque on the rudder of from 30 to 40 percent, which reduces the strain on the steering gear and makes it possible to maneuver the ship more easily.

Tank ships are constructed with a number of compartments, formed by horizontal and longitudinal bulkheads.

In the average tanker, the compartments are arranged as follows, working back from the bow: fore peak tank; fore hold for package freight and a tank for water ballast; cofferdam; cargo tanks; pump room; cargo tanks; cofferdam; bunker for fuel oil; space for boilers and machinery; and fresh water tanks. In addition to the deep cargo tanks, there are also "summer" tanks. These are long, shallow compartments situated above the deep tanks along the sides of the ship. They are used when carrying light cargo such as gasoline or naptha. Some tankers are built with two longitudinal bulkheads instead of one, forming a greater number of compartments of decreased width.

THE cargo pumps, usually located amidships, naturally vary in size and number according to the size of the ship. The output of each pump ranges from 150 to 400 tons per hour. The customary discharge pressure is between 50 and 100 pounds per square inch. In many installations, the ship's pumps are operated by steam, as are the winches, windlass, and other auxiliaries. In the new Federal-built tankers, all such equipment is electrically operated.

The pumps are used for unloading, "trimming," equalizing the cargo in the various tanks, and taking on and unloading water ballast when the ship is otherwise empty. When taking on a cargo, pumps on shore do the loading except in ports where gravity pressure can be used.

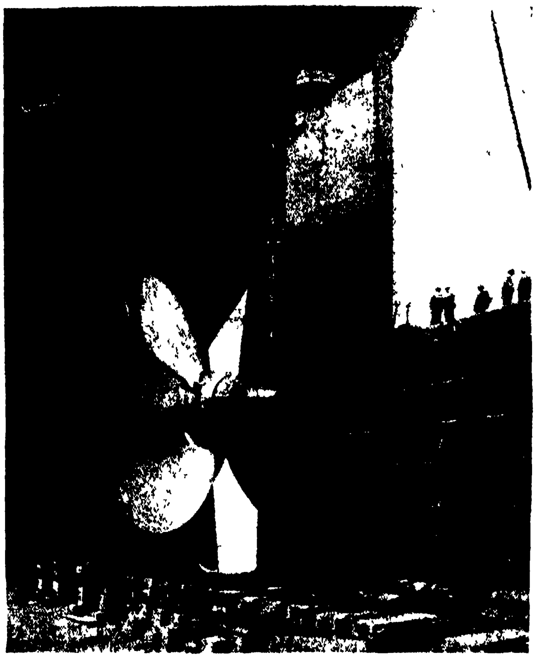
To load a ship properly with a liquid cargo is a task which requires real teamwork, good judgment, and long experience. Should the officer who is supervising the loading fail to give the shore pumpman the signal at just the right moment, the tanks may take on the appearance of miniature gushers. Cleaning the deck is not a pleasant task, after such an occurrence, and of course to lose oil is to lose money. More important, however, is the necessity of keeping the overflow from contaminating the water near the loading dock. To pour oil on the waters is an unpardonable offense in any port.

It requires only five or six hours to load or unload the largest of the oil tankers, some of which have a capacity up to 150,000 barrels. Consequently, ships of this type are able to spend practically all their time at sea, with waste time reduced to a minimum.

American oil was transported across the Atlantic ocean as long ago as 1861. Before the days of steamships, tankers were busily crossing the seven seas.

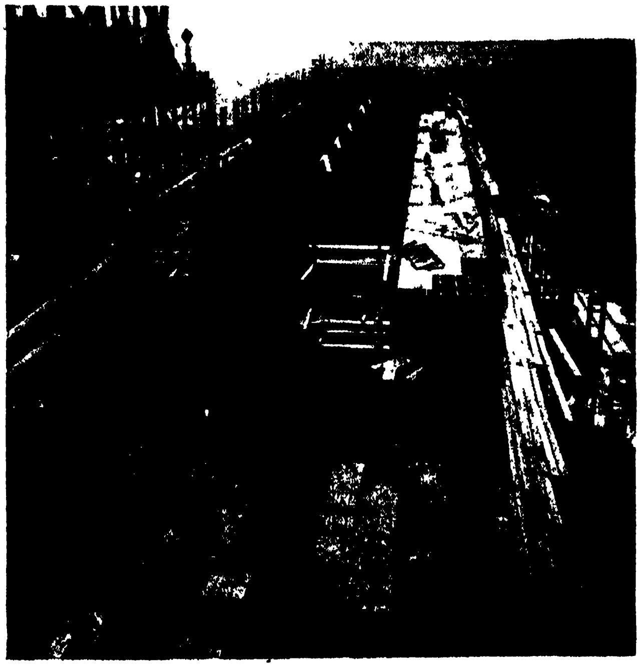
For a long time, domestic transportation of petroleum and its products was handled almost exclusively by river barges and railway tank cars. With the construction of extensive underground pipe-line systems, it seemed that oil could be transported almost any distance by that method. Economy, however, added another chapter to the story.

The longest of the oil pipe-lines was a 1700-mile trunk line extending from the mid-continent fields to Bayonne, New Jersey. Originally it was an oil line, transporting the raw material from the oil fields to refineries on the eastern seaboard. Now it transports gasoline—the finished product—from the eastern refineries to one of the most important consuming areas in the middle-west. Thus the order of supply is reversed, for the oil companies have found it more economical to supply their eastern refineries with crude oil brought by tanker from pipe-line terminals at ports in Texas, Louisiana, California, Mexico and elsewhere—a task for which these new tankers will soon be launched—and pipe the finished product into the interior. "The old order changeth, yielding place to the new."

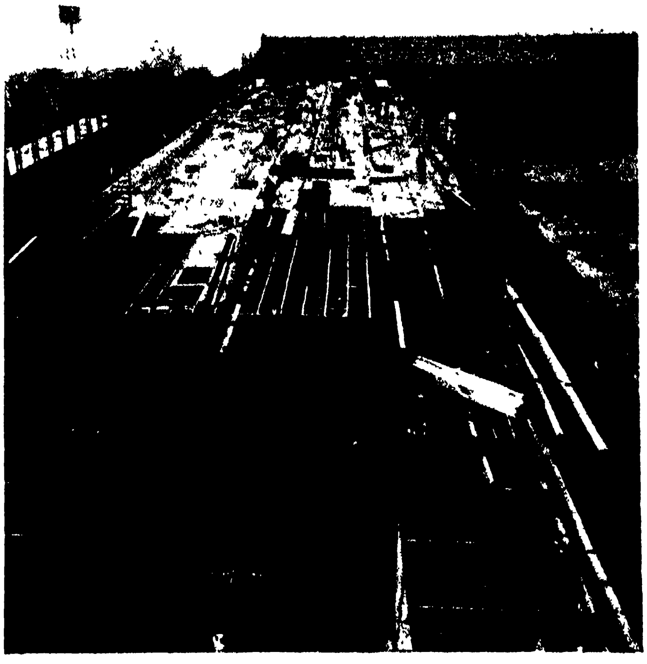


Courtesy Th. Goldschmidt Corporation

Contra-rudder and contra-propeller, the stream-lined design of which saves much fuel



Construction of cargo tanks of a new Standard tanker, with longitudinal and horizontal bulk-heads in place



Later view of construction of tanker with tanks partially covered with plates, and apertures for filling and emptying

TRAVELING HOME FOR 'PHONE LINEMEN

By C. W. GEIGER

NO longer does the lineman whose duties take him to the wide open spaces and the sagebrush wastes of Nevada have to shiver through long nights in zero weather. No longer does the truck driver have to haul water 14 miles to camp. No longer—ah, well, the old-timer who did his hitch in '14 when they built the T-C lead shakes his head and mutters something about times not being what they used to be. He mutters something about the coming generation getting softer, or having it soft, or some such remark that betrays a bit of wistful reminiscence rather than envy.

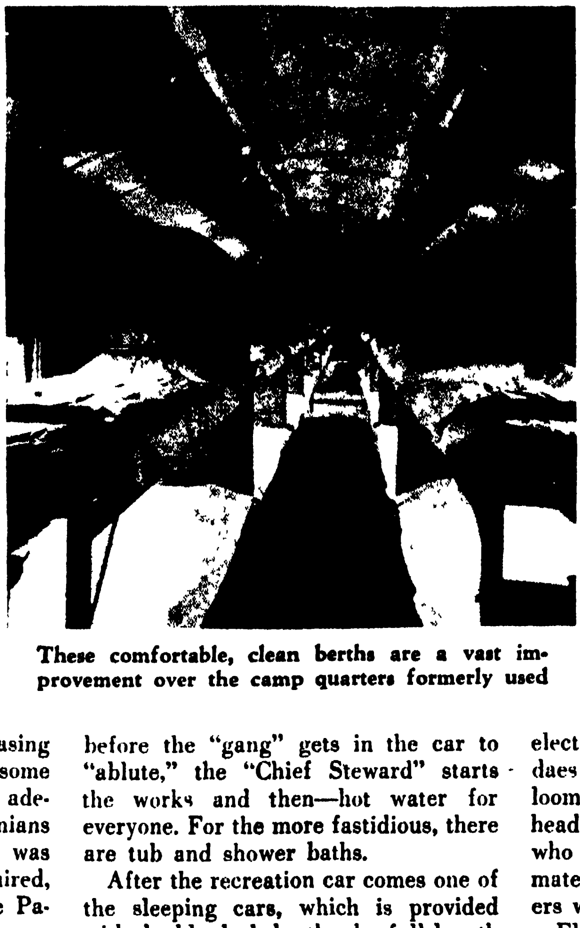
For today telephone men in the sagebrush country are residing in "private" cars. They are real, honest-to-goodness private cars. These cars were purchased by the Pacific Telephone and Telegraph Company from the Southern Pacific Railroad Company and remodeled under the supervision of the telephone company.

FOR many months construction crews from California have been "farmed out" on the desert. With the completion of each job, however, a new one was devised, for work in the Silver State is no longer a seasonal activity, and the growth of the telephone business has demanded all-year activities.

When it is 10 degrees below zero, Nevadans consider it a light frost, so with the ever-increasing demand for telephone circuits, some steps had to be taken to provide adequate living quarters for Californians engaged in desert work. When it was definitely decided what was required, the Supervisor of Supplies of the Pacific Telephone Company began negotiations with the Southern Pacific Railroad Company and, as a result, the linemen now have a complete "home sweet home" of seven cars, comprising material, water, commissary, kitchen and dining, recreation, sleeping, and foreman's cars. The whole unit will take care of 40 men.

The Threlkeld Commissary Company, which provides the meals, occupies one car, remodeled to provide a commissary and sleeping quarters for the Chinese cook and the waiter. From this car the kitchen help can walk into the dining car, which has been rebuilt to provide a kitchen the full width of the car with an adjacent horseshoe counter.

Following the dining car is the recreation or club car, which is equipped with a radio and tables for cards and reading. What was formerly the kitchen of this car, when it was in active service on the railroad, has been remodeled into a bathroom de luxe, featuring heating arrangements better than some bachelors have at home. Forty minutes before the "gang" gets in the car to "ablute," the "Chief Steward" starts the works and then—hot water for everyone. For the more fastidious, there are tub and shower baths.



These comfortable, clean berths are a vast improvement over the camp quarters formerly used

After the recreation car comes one of the sleeping cars, which is provided with double deck berths the full length of the car. The next car is the foreman's car, equipped with single berth cots, and, located at one end, the foreman and clerk's sleeping and office quarters.

A two-kilowatt automatic lighting unit furnishes the electricity for lighting. When any light is turned on, it automatically starts the motor and instantaneous lighting is then furnished throughout the cars as required. Turning off the last light stops the motor. To provide water throughout the train, a pressure pump has been installed, hooked up with the lighting unit. This scheme gives water pressure equal to the usual city pressure.

The railroad car home is indeed a tribute to the efforts of the management of the telephone company to provide adequate protection and accommodations for those whose duty takes them to the barren wastes.

Another and similarly equipped special train with 80 men on board is being used in building a long-distance telephone line across the sands from Barstow to Las Vegas. The project, involving 826,000 dollars, will provide 85 simultaneous talking circuits between southern California, the Hoover Dam territory, and certain desert towns that have never yet had telephone service. The circuits will be extended later to Salt Lake City. Pressing telephone requirements have developed in this section of the west, and the specially equipped construction train departed as the best answer for the situation.

INCLUDED in the train are three sleeping cars, a dining car, a commissary car, a bath car, a supply car, and a water car. Although the men will be in the warm environs of the desert for several months, each day's toil will be forgotten in the 12 shower baths in the bath car.

The men have their own lighting system aboard, together with electric refrigeration. Ice cream sundaes on the fringes of Death Valley loom as possibilities, according to the head of the commissary department, who has planned to deliver approximately 20,500 meals to the hungry workers while en route.

Electric fans are also installed in each of the coaches. The dining car contains a table more than 60 feet long, capable of seating the entire personnel. The club car contains regular day-coach chairs, card tables, a phonograph, and other equipment to make the desert headquarters home-like. The train was purchased by the telephone company and the interiors of the coaches were refitted to suit the needs of the expedition.

These modern telephone pioneers began their activities just east of Barstow. Augmenting the telephone train are 10

The important room where harmony and contentment among members of the crew are insured: the kitchen car, a Chinese cook, and a waiter

Below: When the dinner bell rings, out on the desert, this is a busy room. Note the "U" counter

Below: The wash room on the telephone construction train. The equipment consists of a long sink with many faucets, tub and shower baths, and hot water heaters for the baths

Below: After a hard day's work, the crew finds relaxation and entertainment in the recreation car which is very popular

new motor trucks ranging in capacity from 1½ to 10 tons each, four tractors, and several congenial Missouri mules that are to add the color of the past to the expedition.

More than 12,000 poles and cross-arms will be used in constructing the 10-wire copper span across 150 miles of desert country. Pyrex glass insulators, numbering 160,000 will be used for the first time and provision has been made for 90,000 feet of guy wire.

The construction men are building approximately two miles of long-distance line daily. They sleep in a different spot practically every night. A farewell comparable to some of those enacted at railway stations during the World War took place when the train left its siding in Los Angeles and the families of the 80 telephone men bade them goodby.

The efficiency of the preparations made for this great project, and the amount of careful detail that has been worked out in connection with the expedition, caused a great amount of comment in southern California. As a result of the work of these men in the desert, the east and the west will be brought into closer contact, and provision will be made for the rapidly increasing long-distance telephone traffic between the people of the Pacific Coast and their friends and business associates across the Sierras

Noteworthy, also, will be the part that this long-distance circuit will play in the construction of Hoover Dam.

AVIATION IN 1930

By PROF. ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University
Associate Editor, *Scientific American*

AIRSHIP enthusiasts have been greatly encouraged by the year's developments. In Akron, under the auspices of the Goodyear-Zeppelin Corporation, the 6,500,000 cubic-foot airship *Akron* is advancing rapidly. Seven main frames, and 18 intermediate frames are in position, representing 525 feet of the ship's total length of 785 feet. This dirigible has been called the "airship of 6,500,000 rivets"; stood on end it would be equivalent in height to a skyscraper of 80 stories.

Driving rivets in the airship is not the noisy process we associate with the construction of a skyscraper. The dural rivets, heat-treated in an electric furnace, are taken from the furnace, immediately quenched, and then simply squeezed into position by a manually operated tool.

The airship is to be delivered to the Navy Department in the spring of 1931. With its swiveling propellers, speed of 80 miles per hour, and unequalled dimensions, the *Akron* will mark a distinct epoch in airship development.

THERE are at present only two airship building corporations of importance in the United States. One of these, the Aircraft Development Corporation of Detroit, is actively pursuing its experiments with the metal-clad type of airship in which a thin metal covering, about eight thousandths of an inch in thickness, replaces the conventional rubberized fabric covering of today. The metal-clad airship built by this company and delivered to the Navy's Airship station at Lakehurst, has shown up excellently in service and has successfully demonstrated that the difficulties expected from the very thin metal covering are really non-existent.

It is understood that the duPonts, in conjunction with yet another lighter-than-air company, are producing a synthetic material which will replace the expensive goldbeaters' skin (made of animal entrails) and will reduce the permeability of the gas bags to helium to an almost negligible quantity.

Small airships for private or commercial use have been few in number to date. They have possibilities, however, and it is intriguing to learn that Captain Anton Heinen, the airship pilot employed by the Navy Department in the construction and operation of the *Shenandoah*, is planning to build a number of small airship yachts. These little airships are to be only 104 feet in length with a gas capacity of 39,600 cubic feet. They are designed to have a top speed of 65 miles per hour and are to cost less to operate than an automobile! The plans also call for the use of a detachable passenger car which can operate under its own power as an automobile. This of course would meet the great difficulty of transportation to the airport. It remains to be seen whether the technical difficulties involved in such independent operation can be overcome.

ALTHOUGH the general business depression during the past year has affected aviation adversely, the developments within the industry give promise of a bright future. On these pages Professor Klemin presents a brief yet thorough survey of the situation.—*The Editor.*

Still another encouraging feature of the airship situation is the fact that the proposed airship line between Spain and South America, under combined German, Spanish, and South American auspices, is apparently coming to a head. At any rate Captain Eckener, full of energy and enthusiasm after his successful voyage 'round the world, has definitely begun the construction of an airship for this service. The new airship, the *LZ-128*, is to be finished by the end of next summer. She is scheduled to be 815 feet in length, with a maximum diameter of 130 feet, and a displacement of 5,250,000 cubic feet. Four power gondolas are to be placed on each side of the airship, each equipped with two Maybach motors of 500 horsepower. The airship is planned to be used mainly for mail purposes and is not to be equipped with any degree of luxuriousness. The Spain-South America line is regarded as an even more promising field for the airship than the Germany-Lakehurst route, because the saving of time over the 17-day steamer service is likely to be overwhelming.

The British, on the other hand, are more than satisfied with the flight of the *R-100* from Cardington to Montreal and back. The voyage from east to west, beginning on July 29th, took 79 hours of flight, with eight hours delay due to repairs in flight. The return trip of 57 hours 5 minutes was very close to the record time of the *Graf Zeppelin.* The *R-100* navigated successfully through fog, and when it was encountered on the voyage also demonstrated the success of a very useful new device whereby water deposited on the cover was collected by a series of special drains leading to a cistern. More than two tons of water were collected in this manner in the course of one morning. This ship was constructed by the Airship Guarantee Company of which Commander Sir C. Dennis Burney is the guiding spirit. As the result of close analysis and of the experience achieved in this successful voyage, Commander Burney predicts large profits on the investment in a regular line.

THE trip of the *R-100* constitutes the eleventh crossing of the North Atlantic by airship, with some minor mishaps it is true, but with not a single fatality on any of the crossings. There would appear to be a good deal in favor of the opinion that the airship is a suitable medium for trans-oceanic travel.

The year has been marked by comparatively little news of helicopter development—with one outstanding exception, the announcement of completion of the Curtiss-Bleecker Helicopter.* The possibilities of the helicopter or direct lift type of aircraft are very great. It is obvious that the ability to rise vertically from a small plot of ground and to land at will in equally restricted territory is very valuable. While it is inconceivable that the helicopter should compete with the airplane for load carrying at high speed, it would be a very valuable auxiliary in air transport work. For military or naval air forces the helicopter's ability to hover over one spot would ensure accurate and deadly bombing. With these possibilities in mind much money and effort and ingenuity have been spent in all civilized countries on the production of a helicopter. Nowhere have really conclusive results been yet reached.

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*For a description of this helicopter see *Scientific American* September, 1930, page 214.

As aeronautics progresses more and more, it cannot be expected to provide us with so many thrilling novelties as in the past. Still there have been a good many novel developments even in this year of general aeronautical depression. One of the most striking is the provision of a parachute for the support of the entire plane, developed by the Russell Parachute Company and successfully tested on a Parks biplane of the Detroit Aircraft Corporation.†

On the first test, the ship landed in a tree, yet the only damage sustained was that of a broken propeller and a bent landing gear axle. There is no doubt that if the plane 'chute proves entirely practicable it will add greatly to the confidence of the traveling public.

AT the same time manufacturers are not neglecting other ways of providing parachute facilities for the traveling public. For example quick-release parachutes have been successfully tried out in recent months. (See page 392, November, 1930, SCIENTIFIC AMERICAN.) The traveler is provided with a comfortable though sturdy jacket at the front of which there is a ring. The parachute is placed conveniently at hand in the cabin; a hook on the parachute can be attached to the ring in an instant. It is true that only a short time ago a girl of 16 jumping from a cabin plane forgot to pull the rip cord and was killed, and it is true that passengers as a group will not take readily to the parachute. Still its possibilities in emergencies are well worth experimenting with.

The only type of aircraft we can recall which may be classed as completely a novelty is the rotor seaplane recently built at Mamaroneck, New York. Considerable mystery attaches to the construction of this seaplane. Instead of the ordinary wings, two cylinders or rotors are placed above and on either side of the fuselage, and are turned by suitable gearing from an engine placed in the fuselage; a second engine drives a conventional propulsive propeller. When the rotors are turning and the seaplane as a whole is in forward motion the rotors give a powerful upward or lifting force. Their action is similar to that of the Flettner rotors used in the Flettner rotorship, *Buckau*. While the daily press grew quite excited about the possibilities of the rotor airplane, it must be remembered that while rotors are very powerful in lift, far more powerful than ordinary wings of the same area, they are also far less efficient. That a rotor airplane can be made to fly is quite likely. That a rotor airplane can be made reasonably efficient is very doubtful. (For a fuller description, see page 392, November, 1930, SCIENTIFIC AMERICAN.)

The year's activity in design, although somewhat curtailed by the general slump in aviation, has brought out several new types of planes. The Daniel Guggenheim Safe Aircraft Competition was instrumental in bringing out the Curtiss *Tanager*, the prize winning plane of the competition. This plane has brought several fine developments to the eyes of the designer, notably the slots, flaps, and floating aileron. The added lift and speed range due to the slot and flap combination has proved very encouraging. (For details of the *Tanager*, see page 232, March, 1930, SCIENTIFIC AMERICAN.)

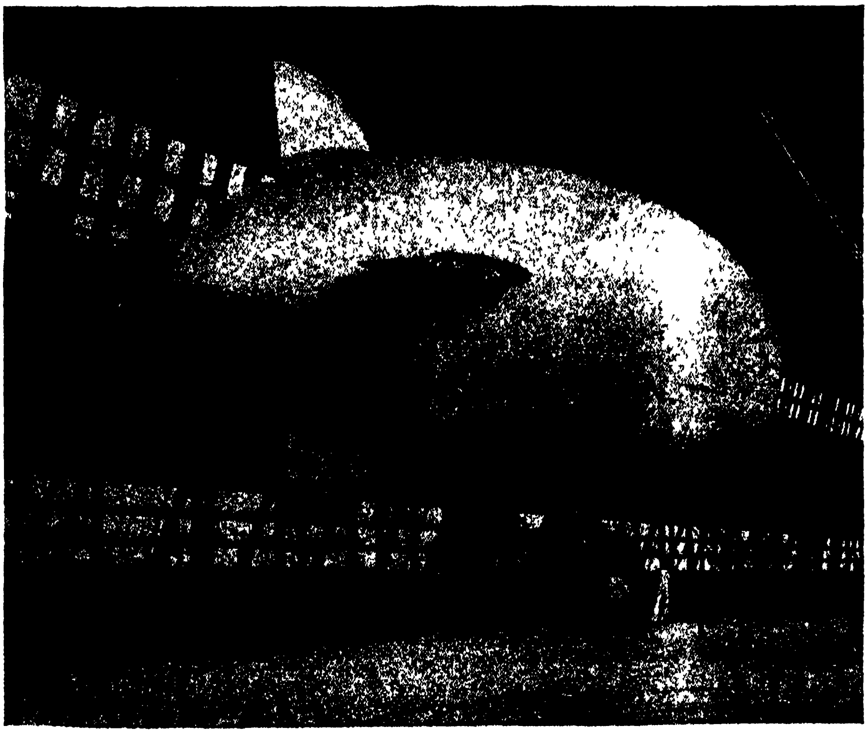
In the light racing and sport plane field, the *Mystery S*, a low wing monoplane designed by the Travel Air Company, has created quite a stir. The *Mystery S* is a typical low wing monoplane streamlined to the highest possible degree. It has incorporated every known device for the reduction of drag such as tapered wings, wheel fairings, elliptical fuselage section, and filleting of all sharp corners. The streamlining of the fuselage is carried through to the rudder, the bottom of which conforms with the shape of the fuselage. The amount of external bracing has been cut to a minimum and where necessary it has been done through use of streamline wire. The landing gear of the *Mystery S* is of unique design.

The shock-absorber strut is a combination oil and spring type held in a vertical N Strut which is attached to a wing stub. Each unit of the landing gear is fastened to its own wing and the wing stub of the opposite side. Most of the wheel and mechanism are enclosed in a neat fairing. The plane attains speeds in excess of 200 miles per hour equipped with a special 400 horsepower Wright Whirlwind. Many of the small ship manufacturers have followed in the steps of the Travel Air Company and are developing small fast planes but this ship still remains as one of the swiftest and neatest of designs.

A DECIDED trend toward increasing the payload with increase in size of the ship has been confirmed by the construction of several large ships. There is the Junkers *G-38* which has undergone several successful flights at Dessau, Germany. Although the construction of the *G-38* is of usual Junkers metal type, the depth of wing is such that the power plants and cabin passenger accommodations are wholly contained within it. Propellers are mounted out in front of the wing on streamlined bosses and driven by extended shafts from the motors. The plane will carry 32 passengers together with a cargo of freight and mail. Passenger cabins in the wings are available.

In America, the Fokker Company has developed the *F-32*, a large monoplane of usual Fokker construction carrying 32 passengers and having a payload of 8700 pounds. The plane is driven by four motors in two tandem pairs mounted out under the wings. Passenger accommodations are very luxurious and are capable of being made up as a Pullman for night service.

The Commodore flying boats which have been constructed by the Consolidated Aircraft Company and put into service on southern routes of the N.Y.



One of the air-yacht dirigibles designed by Capt. Anton Heinen, prominent airship pilot, mentioned in the text. It is planned to produce them in quantities

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†For full description see *Scientific American Digest*, this issue.

R.B.A. Lines are also additions to the large plane class. These planes are luxuriously equipped for 20 passengers and can be made up for night service.

In the aerodynamics of the airplane there have been no revolutionary changes, but steady refinement and improvement. The ideal of the airplane designer is a flying wing, with everything enclosed as far as possible in the wing itself. The Northrup Company, of California, has carried us a step nearer this ideal. Northrup has designed a pusher airplane, very heavily tapered from root to tip, so that the root of the wing is quite thick, so thick in fact that the small nacelle in which crew and engine are placed is practically hidden in the wing. The Northrup *Flying Wing* is a pusher, with the propeller mounted behind the wing, and the tail surfaces carried on outriggers running from the wing. This is a decided step forward. (See page 389, May, 1930, SCIENTIFIC AMERICAN.)

Vincent J. Burnelli has continued his experimental work with a transport plane in which exceptional cabin space is provided. The Burnelli fuselage is twice as broad as the conventional fuselage, but it is given an airfoil form and thereby contributes to the lift. At the same time the two engines are mounted inside the fuselage, at its leading edge. It is claimed for the Burnelli principle that the relatively enormous passenger space is obtained without any sacrifice of aerodynamic efficiency.

THE Fokker Aircraft Corporation has also been working in the direction of the flying wing. A bomber recently tested has its cantilever wings of such thickness that the fuselage fairs completely into the wing at the root. At the same time the two Curtiss Conqueror engines also merge completely into the thick wing.

In the Boeing mail plane, the *Monomail*, a retractable chassis is another method of reducing resistance.

In discussing thick tapered wings, which provide such excellent spar depth to resist bending moments, it is often said that the drag of the thick wing must be greater than that of a thin wing with external bracing. We have the authority of R. J. Minshall of the Boeing Company for the statement that tapered wings are now available which have an intrinsic profile drag no greater than that of the thin wing of the past.

A striking view of the *Tanager*. The floating ailerons and the wing flaps are plainly visible. This particular plane was destroyed by fire while on the ground

Another aerodynamic development which is meeting with increasing favor is the Townend ring. This is a simple ring a few inches in width, and of slight curvature along its width, which is made to surround the radial air-cooled engine. The Townend ring smoothes out the flow when broken up by the projecting engine cylinders and enables the air to keep streamline contact with the fuselage. The Townend ring achieves the same purpose as the somewhat more complicated Venturi cowling, and is much simpler to build.

In those landing gears which are not retractable, designers are making efforts to reduce resistance by putting "pants" or "spats" over the wheels or by using cantilever struts, just one strut to a wheel instead of the two or three struts previously employed. Some designers have tried fairings which enclose both struts and wheels. Another aerodynamic improvement consists in the use of fillets between wing and fuselage. Experiments at New York University have given an exact rule for the design of such fillets or fairings.

In general the airplane is rapidly approaching its ideal streamline form.

ONE of the most important problems engaging the attention of airplane designers to-day is that of metal covering instead of fabric covering for both the wings and fuselage of an airplane. Fabric covering has the disadvantage of poor maintenance and durability. Metal covering is unfortunately very heavy, even if the thinnest sheet is employed. Since the airplane is under very strict weight limitations, it is only desirable to use metal covering provided the covering itself contributes to the strength. Unfortunately thin metal sheet will not develop anything like its theoretical strength because of local failure termed "crinkling" when the sheet is in compression. The Navy Department and the Army Air Corps are both giving much attention to the problem of the metal-covered fuselage, and in time disconnected efforts of various designers should lead to more accurate knowledge.

The large airplane of the future should have a structure similar in some respects to the structure of the ocean liner, in which the metal plating is already so thick that it can be confidently taken into account in the calculations of strength.

One of the most marked tendencies in the aircraft engine development for the year was the increasing number of inverted, in-line, air-cooled engines of the lower horsepower range which appeared. At both the St. Louis and the Detroit aircraft shows this type of engine was well represented.

Among the newer ones of this type we have the Chevrolair D-6, a six in-line, manufactured by the Chevrolair Motors, Inc. The engine is rated at 170 horsepower at 2000 revolutions per minute. Another of the interesting engines of the inverted type is the Hi-Drive Ensign engine manufactured by the American Cirrus Company. This is equipped with a DePalma super-charger and is rated at 110 horsepower at 2100 revolutions per minute.

THE Fairchild Aviation Corporation have also introduced an inverted six in-line of 110 horsepower.

Engines of this type (inverted in-line) are somewhat heavier than radials of the same horsepower, but their greater simplicity, easier accessibility, better stream-lining and vision qualities are making them more and more popular.

The Packard Diesel, over its first trial stages, is apparently finding acceptance among the aircraft designers and builders. Several transports, including Ford tri-motor and others, have offered planes using this engine.

The L-head engine so popular in the automotive field, has lately entered aviation. The MacClatchie Manufacturing Company has placed a seven cylinder, radial, L-head engine on the market. The difficulty of cooling these L-head air-cooled engines has apparently been overcome in this engine. It develops 150 horsepower at 1900 revolutions per minute and weighs 400 pounds.

Another interesting development among the aviation engines is the increasing number of two-cycle engines that are making their appearance. Several small motors on this principle, of about 30 horsepower, designed for the light plane, have been developed.

The two-cycle engine undoubtedly has great possibilities in the air-

The retractable landing gear on the *Monomail* is said to add 25 miles per hour to the plane's speed

craft field. This is especially true in regard to Diesels. The two-cycle Diesel offers many advantages over the four-cycle gas or oil engine or the present two-cycle gasoline engine. The present two-cycle design has four disadvantages: poor scavenging, delicate mixture control, low volumetric efficiency, poor fuel economy. The so-called "solid injection" of fuel would probably remedy this. The four-cycle Diesel has the disadvantages of weight, high consumption of lubricating oil, and mechanical complications.

THE year has witnessed remarkable record-breaking performances. The re-fueling flight of the Army plane *Question Mark* ushered in a contest to see which plane could stay aloft the longest. Notable among the many flights was that of the Hunter Brothers at Chicago who stayed up for 553 hours in a Stinson *Detroiter*.

Their record was broken by the former record holding team of O'Brien and Jackson who regained their title by staying in the air some 743 hours in a Curtiss *Robin* plane. These flights proved beyond all doubt the feasibility of long, refueling flights.

Two other record breaking flights were made during the year. The first of these was that of Lieut. Apollo Soucek of the United States Navy who reached an altitude of 43,166 feet in a Wright *Apache* plane. The Navy personnel had been experimenting for more than a year on improving the performance of the plane and no factor was overlooked which might raise the ceiling of the plane. When a study of the research data is complete the flight will assume a greater meaning to aviation.

The second flight was that of Capt. Hawks who put up a new trans-continental record in his 12¼ hour coast-to-coast flight. The flight was made in a Travel Air *Mystery S*, the actual air time being 11½ hours, three quarters of an hour being consumed in three refueling stops.

One of the reasons for the disappointing showing of the aviation industry this year is the slow growth of private flying. The reasons are easy to find. In spite of the results of the Guggenheim Safe Aircraft Competition, few manufacturers have sought to embody in their airplane designs the latest aerodynamic safety devices. Well-informed opinion is that while planes are much safer than they used to be, they are still far from the ideal.

Airports and fields are much more numerous than they used to be, but still far from being immediately accessible. A plane is expensive to purchase and expensive to maintain. All these obstacles will disappear, but they have not disappeared as yet. The position of the private plane owner is not at all that of the automobile owner but rather that of the motor-boat owner a few years ago, who had to exercise skill, knowledge, and determination to derive pleasure from his craft.

A RECENT survey of the situation by *Aviation* gives a very fair picture of existing conditions. The typical private plane owner of to-day is a man in his early thirties, with an average income of about 8000 dollars a year. There is no typical occupation for the plane owner. He may be an advertising man, a junior executive, a broker, publisher, or salesman. He flies because he likes it.

Those men who purchase airplanes from a business point of view seem to find their investment a disappointing one. The average monthly flying time is only 13 hours and 24 minutes or about 160 hours a year. Flying is generally a matter of Saturday afternoons and Sundays. Some owners turn their craft over to professional pilots for passenger-carrying work during the week in order to defray expenses. Crack-ups are fortunately few. The enthusiasts who fly for pleasure know their business as a rule and they are not under compulsion to fly in all weathers as are air-mail pilots, for example. With this short flying time per year, and the rapid obsolescence of the modern plane, the question of "trade-ins" will certainly bother the trade in the very near future.

Owners find the maintenance of their craft quite onerous; as it is always necessary to inspect control wires, gas lines, landing gear, and so on, some 28.6 percent of the owners employ professional help.

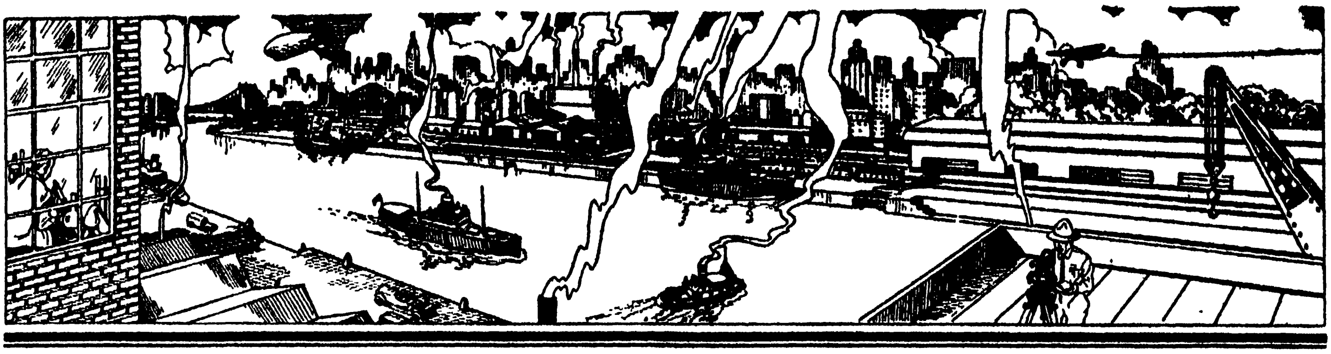
The most popular type of privately owned plane is the three-seater open cockpit machine, with an air-cooled engine of between 150 and 225 horsepower. It is expected that the cabin plane will take the place of a good many of the open cockpit machines, and manufacturers are anticipating this change in demand. In spite of the fascination of the flying boat and amphibion, few private owners purchase such craft. The drawback is in expense. It is gratifying to see that a few manufacturers are turning their attention to inexpensive amphibions.

Aviation country clubs are a splendid social outlet, but the expenses of membership added to the flying expenses have checked the growth of this type of organization. The most promising line of attack would be the formation of flying clubs on the English model clubs where inexpensive, low-powered machines are employed, general expenses are restricted to essentials, and no attempt is made to provide a luxurious social atmosphere. The many English flying clubs have of course been fostered by direct government subsidy.

THE present status of aviation safety is naturally a matter of considerable public interest. Perhaps the most authoritative statement on the subject yet issued is the Report of Committee on Aviation Statistics of the Actuarial Society of America, which was compiled with the co-operation of many governmental and private agencies. It is impossible to present even in summary the findings of this report, which deals with every aspect of the subject, but the comparison with railroads will give a graphic view of the situation.

The Accident Bulletin of the Interstate Commerce Commission for the year 1928 shows a rate of .003 passengers killed per million railroad passenger miles. Only about one fifth of these

(*Please turn to page* 488)



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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HUGE LODESTONE SPECIMEN

AN extraordinary specimen of lodestone, weighing more than 400 pounds, and possessing unusually powerful magnetic strength, has been placed on exhibition in the department of geology at Field Museum of Natural History. The huge natural magnet comes from the Wasatch Mountains in Utah.

The average boy who likes to mystify his friends would give his last cent for a small piece of this 400-pound natural magnet from Utah

Lodestone led to the invention of the magnetic compass by the Chinese in the 12th Century. It is one variety of the mineral magnetite which has the property of attracting iron and other metals. A steel needle placed in contact with a lodestone will in a short while become so magnetized that, if free to move, it will point toward the north pole. It was observance of this fact that suggested the compass.

The attraction of the lodestone for iron was known hundreds of years before the polarity of the mineral was discovered, according to Dr. Oliver C. Farrington, curator of geology at the museum.

"Thales of Miletus (630-550 B.C.) mentions this power of lodestone as do a number of the later Grecian sages," states Dr. Farrington. "There is a fable that the discovery of the lodestone was made by a Cretan shepherd who noticed that his iron-pegged sandals and iron-shod crook clung to the earth. Digging into the ground he found lodestone.

"In classical times and during the middle ages, extravagant tales based upon a misconception of the power of lodestone were current. There were stories of magnetic domes which held statues of iron and even of brass suspended in the air, and there were accounts of mountains of lodestones which drew all the iron nails from ships which ventured near them, so that vessels sailing those seas were obliged to use wooden pegs for nails.

"Discovery of the compass has been attributed to many peoples of Europe and Asia. Many accounts of the early use of the compass are now believed to be mythical. One of these credits the Chinese emperor Hoan-ti with constructing in the year 2637 B.C. a chariot on which was a female figure which always pointed south, and there are other Chinese accounts of the use of these 'chariots of the south' at various times antedating the Christian era. Some European authors seem to indicate an occasional use of the compass as early as the 3rd Century but the first authentic records of its use do not antedate the 12th Century. Shortly after this time the compass came into general use by mariners. The first compasses were magnetized steel needles which were fastened to chips and reeds and floated on water."

THE CHEMISTRY OF RIPE OLIVES

WE have often heard that one has to cultivate a taste for olives, but while we readily confess to a weakness for the more common green olive, we have never been able to get up much enthusiasm for the ripe, or purple, variety. A possible explanation for this prejudice came to our attention recently in reading an article in *Industrial and Engineering Chemistry* by James G. Vail, vice-president of the Philadelphia Quartz Company. Mr. Vail informs us that ripe olives are treated in a solution of caustic soda before they are considered fit to eat. Now, any chemist can tell you that when you treat olive oil with caustic soda you get castile soap. With that fact in mind, it suddenly dawned on us why we never cared for ripe olives.

Actually, of course, if any soap is produced by this caustic treatment it is only in infinitesimal amounts. The subject is of interest, however, because Mr. Vail has discovered that a sodium silicate solution, which will not saponify the oil of the olives, seems to serve just as well as the customary caustic soda. Indeed, by using silicate solution, the olives may be allowed to ripen further on the tree and still yield a firm texture. The flavor of the fruit treated by the new process is said to be better. —*A. E. B.*

EINSTEIN, LIVING IMMORTAL

NOT that Einstein "needs the publicity"; or that the fact that most men of science regard him as the greatest scientist, fit to rank with Newton, really requires constant reiteration; but because the editors from time to time receive communications from persons who either request confirmation of his high standing in science or, as sometimes occurs, wish to have their private opinion confirmed that he is a "faker" (as one rather excitable anti-Einsteinian repeatedly put it), attention is called to the recent tribute of the Riverside Church in New York which has chosen to include a carved figure of Einstein with those of the world's very greatest on the tympanum of the doorway of its new edifice.

A white oval has been marked on this illustration to show the location of the carved statue of Dr. Einstein over the main portal of the Riverside Church, New York City

Einstein is the only living person thus to be honored. The action of this church brackets his name with those of Socrates, Plato, Aristotle, Descartes, Spinoza, and Kant, the philosophers; Moses, Buddha, Saint Francis of Assisi, Luther, and Calvin, the religious leaders; and Galileo, Kepler, Newton, Faraday, Darwin, and Pasteur, the greatest scientists of all time.

The vast majority of men of science will concur in this selection. We believe that the statement of the physicist Heyl, that the majority of men of science qualified to judge—the physicists and astrophysicists—tentatively accept the Einstein Theory, will bear up under unbiased investigation.

Perhaps the fact that the newspapers have "made so much of" Einstein has tended to confuse some of the people. Certainly, at any rate, there is enough precedent—newspapers taking charlatans seriously—to make this kind of judgment seem plausible. But in this case the newspapers are right. Whoever permits himself to believe that Einstein is not looked up to by men of science should stop taking seriously the vitriolic phrases of a few superheated anti-Einstein cranks and should go among men of science where they are likely to obtain a new orientation.

Another naive question sometimes is asked: "Is Einstein really Jewish?" Einstein is a Jew.

Mr. Pratt at work on his new equipment for photographing small life

EXPERT FINDS WAY TO PHOTOGRAPH SMALLEST LIFE

THE tedious work on the part of artists in illustrating minute forms of animal and plant life which can only be seen through a microscope, has finally been overcome by J. G. Pratt, scientific photographer for the United States Department of Agriculture.

Heretofore biological subjects could only be photographed satisfactorily from 10 to 15 times their natural size, which was not sufficient, and such subjects have always been drawn by artists, requiring hours of labor looking through a microscope, with little assurance that the resulting illustration was true to nature.

The difficulties encountered in photography at high magnification have been the flatness of field and the lack of proper illumination. Above 10 or 15 diameters the exposures are so long as to be impractical, and the short focus lenses required do not give sufficient depth of focus. That is, if a tiny insect were magnified sufficiently to see what it looks like, only a portion of its back would be sharply defined, the rest being hazy and distorted.

After years of research Mr. Pratt has just developed a lighting device which is many hundreds of times stronger than sunlight, and also lenses which give great depth of focus, making possible the photography of animal and plant subjects up to as high as 300 diameters.

Mr. Pratt states that photo-micrography at such extreme magnification has heretofore been confined to metallurgy, on subjects which are flat and reflect a great amount of light; and that the new development should revolutionize the illustrating of biological subjects, which have considerable depth and reflect little or no light. He says that where previously the exposures for a magnification of 10 diameters took several minutes, only a few seconds are required for as much as 200 diameters with the present lighting device.

ULTRA-VIOLET TRANSMITTING GLASSES

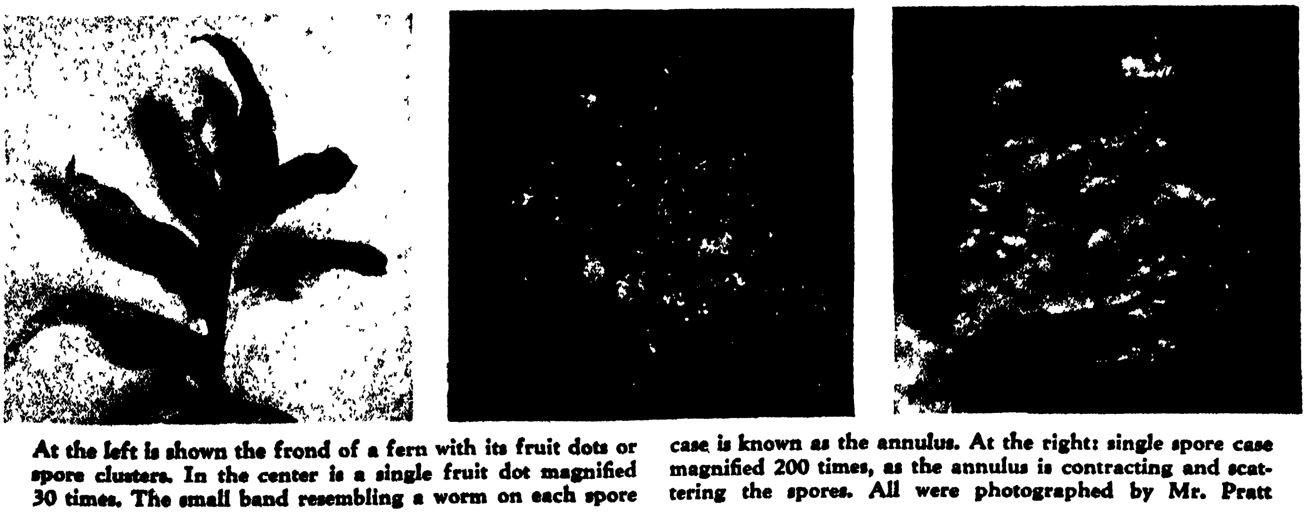
THE Council on Physical Therapy of the American Medical Association has made available a study of the value of glass of various types for transmitting ultra-violet rays. Dr. W. W. Coblentz of the Bureau of Standards in Washington, who is a member of the Council, points out again that ordinary window glass cuts off the ultra-violet rays, transmitting only 1 to 2 percent and being completely opaque to radiation of the shorter wavelengths. The maximum value of ultra-violet rays appears to be in the wavelengths from 297 to 302 millimicrons. Only a weak effect, if any, is obtained with longer wavelengths.

So far as the prevention of rickets is concerned, only window glass which has a transmission of 30 percent or higher of wavelengths of 302 millimicrons will give protection. It is understood also that the amount of ultra-violet received from ordinary sunlight is modified by altitude, latitude, time of day, the season of the year, and the amount of smoke. Obviously therefore only glass that will transmit ultra-violet freely is of any use. In the ordinary home it is perhaps better to do without window glass altogether for the room in which the child is to be sunned, and to use instead some sort of substitute.

The various devices for producing ultra-violet rays have been standardized by the Council on Physical Therapy of the American Medical Association, and inquiries concerning any special variety of lamp are answered with statements as to actual virtues in providing ultra-violet.—*M. F.*

CHILDISH DRAWINGS ON WALL OF ROMAN HOUSE

ONE family of ancient Rome would no doubt be greatly entertained if it could see archeologists of 1930 poring over the scrawled drawings made on the walls of their house. The drawings, recently discovered, are such as children of ancient



At the left is shown the frond of a fern with its fruit dots or spore clusters. In the center is a single fruit dot magnified 30 times. The small band resembling a worm on each spore case is known as the annulus. At the right: single spore case magnified 200 times, as the annulus is contracting and scattering the spores. All were photographed by Mr. Pratt

Rome, or any other time and place, enjoy scribbling on a handy piece of clean wall space.

The house of these wall decorations stood in the famous Appian Way about the time the Roman Republic became the Empire of Rome. Its ruins have lain buried beneath almost 40 feet of earth, and a Church of San Sebastian stands over the site.

Prof. Francesco Fornari, Roman archeologist who has been studying the mural sketches, sees in some of them pictures of fighting gladiators armed with shields, spears, and swords. Another sketch is believed to show an individual being burned. Rows of long and short lines, rising before this person, indicate flames, and there are soldier-like figures on each side who appear to be stirring up the flames with their spears. It is considered likely that the drawings were made by the children of some Roman fighter's household.

Other parts of the walls are adorned with frescoes done by more professional hands. —*Science Service.*

THE BELLANCA "AIRBUS"

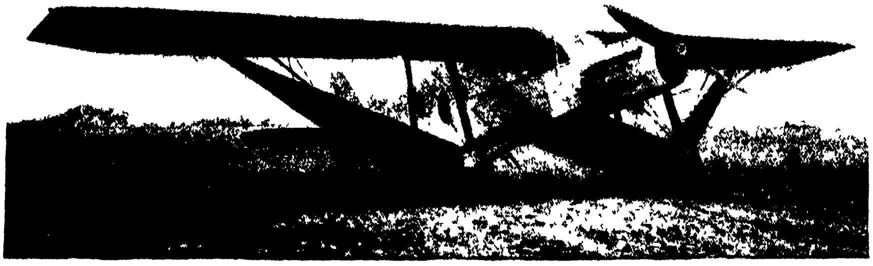
G. BELLANCA of the Bellanca Aircraft Corporation is a designer who can be relied upon to produce original and worth-while modifications from standard practice.

For the designer of transport airplanes, there are two outstanding problems at the moment. One is to give the operator a greater payload for a given horsepower, thus making operations more economical—but without reducing speeds. The other is to provide him with a craft which will enable him to take full advantage of the Watres Bill, under which the Postmaster General can hire space in passenger-carrying planes, and which, therefore, necessitates the construction of planes to carry both mail and passengers.

The Bellanca *Airbus* certainly appears to meet these requirements by excellency and originality of design.

The main wing, mounted on top of the cabin, is similar to that of a conventional braced-wing monoplane with the exception that each wing is divided into two panels. The inner or center section panels of the upper wing, in conjunction with the lower stub wings, form the inner bay and are joined together by struts of round, chrome-molybdenum steel tubing, faired with balsa wood. From the outer end of each stub wing another lifting surface called the auxiliary wing goes up to meet the outer panel of the upper wing.

What is remarkable in this system of wing construction is that both the stub wing and the auxiliary wings serve a number of purposes. The auxiliary wing serves to brace the upper wing like ordinary struts, but also provides lift. The lower stub wings are even more useful. They provide lift, form conveniently a part of the landing gear structure, and also contain the waterproof metal-lined mail compartments which have a capacity of approximately 60 cubic feet, and which, placed in the stubs, do not encroach on the passenger compartment. The advantages of this peculiar wing system are obvious. The auxiliary wings do not just introduce air resistance when performing their bracing function: they lift and carry load. The stubs carry load, yet they give ideal support to the landing gear. There is a general gain in efficiency.


The Bellanca *Airbus* has a novel system of wing trussing

The landing gear of the *Airbus* also represents a departure from conventional practice. The wheels go into recesses at those ends of the stub wings where the auxiliary wings join. The wheels are cushioned and kept in their proper position by oleo struts; the struts are attached to beams running from front to rear of the landing gear recesses. The wheels disappear almost completely into the stubs, yet at the same time they are well below the fuselage of the plane. This type of landing gear, therefore, attains many of the advantages of the retractable landing gear without its mechanical complication.

The control system introduces a wrinkle, not new perhaps, but interesting. Each aileron is separately connected to the control wheel, so that if one aileron becomes inoperative, there is the other to count upon.

In the passenger cabin, there is another minor yet useful idea. The passenger seats on each side of the cabin are on a platform 12 inches high. This leaves a sunken aisle down the middle, permitting a tall man to stand erect. The baggage is conveniently stored beneath the platforms on which the seats rest.

With a Curtiss Conqueror 600 horsepower engine, with 4000 to 4500 useful load—say 10 passengers, 250 pounds of baggage, some 1000 pounds of mail, and 200 gallons of gas—the high speed is 147 miles per hour, the cruising speed 125 miles per hour.—*A. K.*

AN AIRPLANE PARACHUTE

MUCH thought and effort have been expended on the design and use of parachutes for passenger service. Recently we described in these columns a quickly-detachable and attachable parachute for passenger use. There always remains the question, no matter how easy the use of the parachute may be made for the passenger, of whether the average passenger will have the presence of mind to avail himself of this device or whether he will pull the rip cord neither too early nor too late. Many authorities are of the opinion that the better plan is to provide a parachute for the entire plane. The Russell Parachute Company has developed such a "ship parachute," as it is frequently called, and, with the co-operation of the Detroit Aircraft Corporation, has recently tested out the apparatus on a Parks two-seater biplane of about 1800 pounds gross weight.

Aviation describes the apparatus in somewhat greater detail than the reports of the Russell Parachute Company itself:

Loading the airplane parachute in the tail of the fuselage. The pilot 'chute which is contained in the cup pulls the large 60-foot 'chute from the cylinder

"Except for a control lever in the cockpit, four suspension cables attached to the plane's center section, and, of course, the control lever cable, the entire device is enclosed in a metal tube, made scarcely noticeable by being faired into the bottom of the fuselage. The tube is about 11 inches in diameter and extends from a point directly below the center section to a point below the rudder hinge line.

"The 'chute, 60 feet in diameter, is folded inside a metal container, or 'split can' located all the way forward in the tube. The 'can,' which is round, has an inch clearance between it and the inside wall of the tube. Runners inside the tube hold the 'can' in exact center. The four suspension cables extending from the lower shroud lines of the 'chute to the plane's center section are run out of the forward end of the can, through guides located between the can and the inside walls of the tube to a streamlined cap on the after end of the tube. They then extend through an opening in the cap, thence to guides located near the top of the rudder post, after which they are carried to the plane's center section by means of additional guides on the back of the fuselage. Between the streamlined cap and guide atop the rudder post, two cables extend along the two sides of the fuselage to prevent the parachute cables fouling on the tail surfaces.

"The pilot's control cables extend directly from the cockpit to the cone-shaped cap which is attached to an 18-foot pilot or 'drag' 'chute. Operation of the device is as follows: When the pilot lifts his lever in the cockpit, the cone-shaped cap flies off the tube, releasing the drag 'chute. By means of the drag cable, the small 'chute pulls the split can containing the large parachute out of the tube. Upon being released from the tube the split can opens and releases the large 'chute, which pulls the cables from their guides, thereby suspending the plane from its center section by means of the four suspension cables."

The whole apparatus weighs only 100 pounds, and it is claimed that it will right the airplane from any difficult position and bring it down at a speed of 16 feet a second, which will mean a rough but perfectly safe landing.

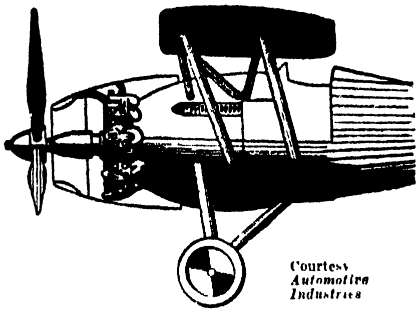
On the first test, the Parks biplane landed in a tree under conditions approximating those that would be encountered during emergency use. The only damage sustained was a broken propeller and a bent axle.

Further tests will be awaited with interest.—*A. K.*

COWLING-IN THE RADIAL ENGINE

THE great objection to the radial air-cooled engine is that the projecting cylinders not only have large resistance themselves, but that they also break up the streamline flow over the fuselage and thereby introduce still more "parasite" resistance.

A. H. R. Fedden in a paper before the Institution of Mechanical Engineers (of England) visualizes a completely cowled-in radial engine, shown diagramatically in the accompanying sketch. The cowling is of streamlined form itself, and blends with the streamline design of the rest of the fuselage. The propeller is of necessity mounted on a shaft extending somewhat farther from the engine than in the conventional type of engine. Through a circular hole at the front end of the cowling only enough air is admitted to cool the motor. The cooling air then passes through a circumferential gap, behind the engine, and at exit combines, with minimum disturbance, with the main flow around the fuselage.


Courtesy *Automotive Industries*

Fedden's conception of a cowled-in, radial, air-cooled engine to correct objectionable features of this type

Certainly such cowling-in should be decidedly beneficial to the over-all performance of the airplane, and we do not see that it offers any insuperable difficulties of a mechanical character.—*A. K.*

FLEXIBLE-WING PLANE

WE append two photographs of the Waterman "fool-proof" plane built in Los Angeles. The complete technical details are not yet available, but the principles of the invention will be deduced from our photographs.

The outer portion of the wings is not rigidly connected to the airplane. It is rather hinged about the wing stubs adjoining the fuselage and controlled by the action of the two struts which can slide in and out of the hydraulic cylinder mounted on each side of the fuselage. By means of this hydraulic adjustment, the dihedral, or V, of the wings can be changed at will and therefore the lateral stability of the plane can be varied to suit flying conditions or the pilot's preference.

We believe, but we are not quite sure, that when the V is increased, the angle of incidence of the outer portion of the wing is somewhat increased. This means that the wings can be set at the angle most appropriate for high speed, for cruising, or for climbing.

The movement of the piston in the cylinder is controlled by the pilot, but the wings are also slightly automatic in action and therefore respond to gusts striking the airplane. If the wind gust is such as to tend to raise the left wing, then the left wing will yield, thereby decreasing the effect of the gust. If the gust strikes both portions of the wings from below, both wings will yield and the load will be relieved. This might tend to make flying in "bumpy" weather slightly more comfortable. That it will add to the structural strength is doubtful.

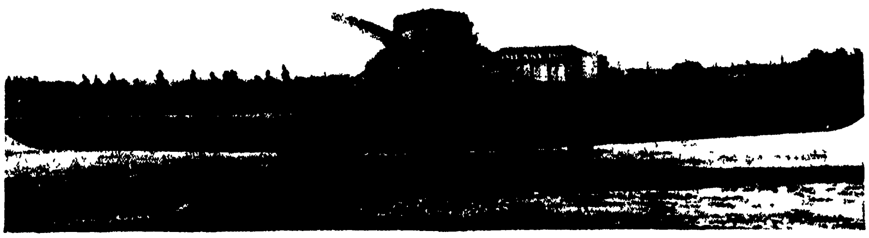
When flying, even in rough weather, the loads due to gusts are small in comparison with the loads which the pilot can impose himself in landing the plane; and raising the outer portion of the wings lowers the machine considerably relative to the ground. This brings into play a huge skid at the front end of the machine. The skid grazing the ground acts as a powerful brake and as the center of gravity has been loaded there is no tendency for the plane to turn over on its nose.

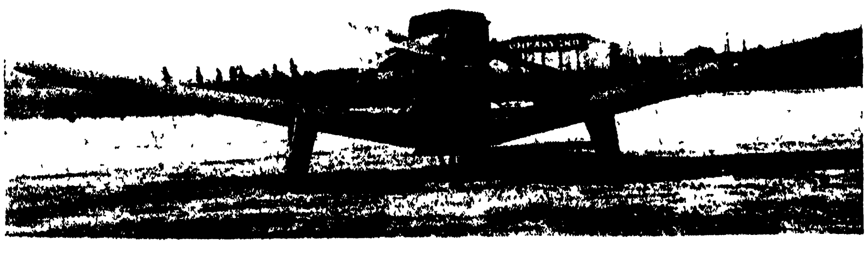
Against these theoretical advantages are to be set the complications of the device. Complete theoretical and practical investigation of the device would be necessary before its value could be determined. But Mr. Waterman has flown his craft safely across the continent and back and that is worth considering.—*A. K.*

SAFETY DEVICES IN BIRDS' WINGS

BIRDS are the result of the survival of the fittest through countless ages of flying, we have been flying for only some 27 years. Perhaps we have yet to learn many flying secrets from them. Lieutenant R. R. Graham, writing in a recent issue of *British Birds*, certainly makes a strong case for the possibility of such lessons. (Another exposition on the same subject appeared on page 386, November 1930, *Scientific American*. Editor.)

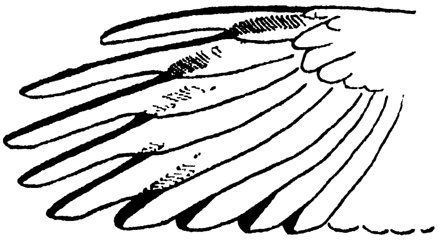
At right: The Waterman "fool-proof" plane in which the wings yield against the restraint of hydraulic cylinders to give less "bumpiness" in gusty weather. _Below:_ The same plane with its wings raised



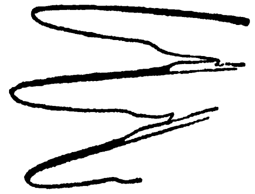


Nature has provided birds of many species with separating flight feathers. A notable example is the wing of the buzzard, seen from below in one of the appended sketches.

The separating flight feathers of the buzzard present what the ornithologists call "emargination." The separating feather is reduced in width from a broad base to a much narrower tip. The result of this arrangement is that when the wing is fully spread, the outer parts of the feathers do not overlap, and gaps or "slots" form between them as is apparent in the same sketch. The feathers radiate or spread out from a fairly small center. Without this emargination the slots would be narrow at the base. With emargination the slots are of a fair width, even at their inner extremities.



Above: **The under surface of the right wing tip of a buzzard.** ***Below:*** **The lower surface of a song-thrush's right wing-tip, with the slots more than fully opened. Gaps appear beyond inner limits of slots**



The feathers are worth a little further study. In the flight feathers of a partridge not only is there some degree of emargination; there is also more width of web behind than in front of the shaft. In aerodynamical parlance the center of pressure of the feathers is behind the shaft.

The result of this "construction" is that when the flight feathers open, they twist upwards at the rear edge (a fact fully confirmed by actual photographs). The flight feathers then offer a series of fair slots, *with the incidence of the flight feathers smaller than the incidence of the main wing.* Surely the flight feathers are in close analogy to the Handley Page multi-slot.

When the bird wishes to descend steeply, he sets his main wing to a large angle with the wind. The main wing is "stalled," loses lift, and acts as a brake. The slotted tips are not stalled and still give lift, and hence there is also lateral control still available. In other words the bird is an airplane or glider which can make a steep, stalled descent, with perfect control.

Of course, as Lieutenant Graham points out, the bird has one point of superiority which is difficult for us to imitate. If the stalled descent is too rapid in a vertical direction, there is danger that the bird will strike ground or water too rapidly. He then flaps his wing back and forth and secures lift by a few strokes just before alighting. A mechanical embodiment of this practically horizontal movement of the flight feathers would be very difficult for us to secure.

Among other wonders of bird "construction" described is a very interesting safety device. A bird's wing tip, with feathers loose from one another, can be drawn so far apart in our hands that gaps appear beyond the inner limits of the slots and barbs are torn apart from each other. This is the case for the song-thrush's wing tip. But when an effort is made to spread the feathers while pressed together, it is found that they will open thus far and no farther. Examination of the feather surfaces with a microscope indicates that the effect is brought about by thousands of tiny hooks which stand out above the main surfaces and engage with the ribbed under surface of the broad part of the overlapping feather.

This is certainly a complete vindication of the value of the Handley Page slot, if the birds are to be credited with knowing something about flying!

MAJOR WILLIAM C. OCKER

WE are very pleased to announce that, after proof of the article "Instrument Flying to Combat Fog," on page 430, had been finally okayed, we received word that its author, William C. Ocker, had been promoted from the grade of Captain to that of Major, Air Corps, United States Army. It was too late to make this change under his name in the byline of the article.

Major Ocker's promotion indicates a rendering of recognition for his splendid ability by the Chief of the Air Corps and therefore gives to his article an even greater authoritativeness, if that is possible.

99.99 PERCENT PURE ZINC

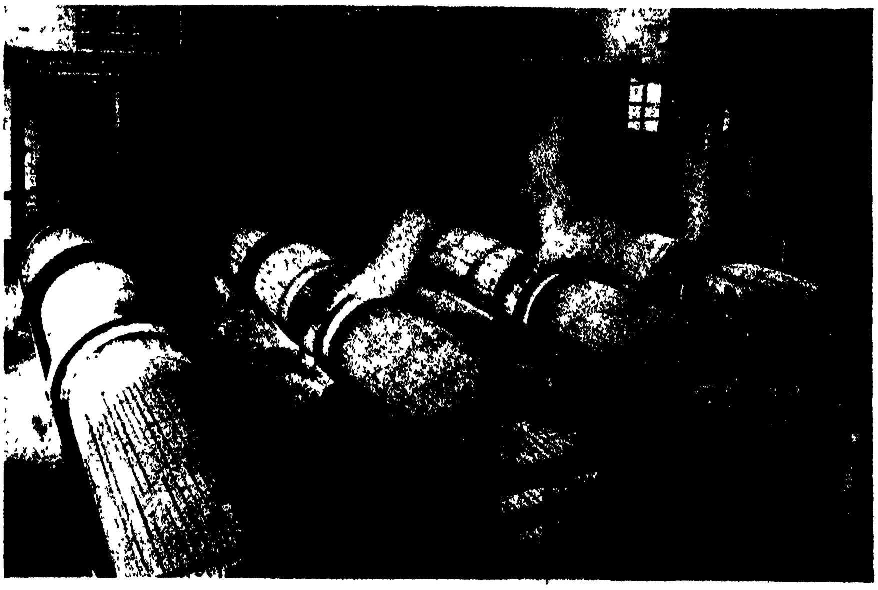
ELECTRO-CHEMISTS of the Evans-Wallower Zinc Company in St. Louis have exceeded the famous record of a well-known soap, advertised as 99.44 percent pure, by developing a process for the production of zinc which is actually 99.99 percent pure. The process is an electrolytic one—the zinc being extracted by dissolving the ore in acid and electrolyzing the resulting solution to extract the pure zinc. Metal of this purity has remarkable properties, being very ductile and possessing high tensile strength. At 350 degrees Centigrade it can be extruded quite readily and drawn into wire.

The process used in this new plant is described by Charles W. Cuno in a recent issue of *Industrial and Engineering Chemistry.* The zinc ore, known as concentrate, contains zinc sulfide and small amounts of cadmium, copper, and iron. The ore is first dried and roasted and then passed through magnetic separators which divide the material into two parts—one high in iron content and the other very low in iron content. The magnetic material which contains the more insoluble zinc is treated with dilute sulfuric acid, in specially designed leaching tanks. The ore is tumbled around in these leachers until the insoluble zinc compounds have been decomposed, after which the non-magnetic portion of the ore is added. During the first stage of the leaching operation, the iron dissolves and is later precipitated as the charge neutralizes the acid. When the leaching operation is complete, the solution and residue are filtered, thus removing the insoluble residue of iron, silica, lead, gold, and silver. The residue is dried and shipped to a lead smelter for the recovery of its metal values.—*A. E. B.*

SOUTH CAROLINA VEGETABLES

THE state of South Carolina is taking seriously the question of the mineral content of its vegetables. A foundation has been established with a research laboratory and enough evidence has already been accumulated to arouse propaganda for California packers to move to South Carolina. The California fruit growers have emphasized the importance of California oranges as a source of vitamin C. The South Carolina Food Research Laboratory counters with a comparative statement showing that California oranges provide 70.5 parts per million of iron as contrasted with 160 parts per million in South Carolina tomatoes; they contain 7.6 parts per million of manganese as contrasted with 26.7 parts per million in South Carolina tomatoes and the oranges contain 4.75 parts per million of copper with 15.3 in tomatoes. Little has been claimed for California oranges so far as concerns their iodine content, but the South Carolina tomatoes contain 166.5 parts per million of this valuable mineral.

The South Carolina authorities, led by Dr. William Weston, recommend South Carolina tomato juice as superior to California orange juice for the growing infant. In their experiments on the feeding of infants, the South Carolina Food Research Laboratory has emphasized particularly



The leaching tanks used in the electrolytic zinc process

heroes must not lisp!

"My thweet" lisped from the screen would mar the star's romantic appeal. But that is something you don't hear in the theatres which have Western Electric talking picture equipment.

To reproduce the letter 'S' was but one of many difficulties in the way of giving you talking pictures at their best. Western Electric was able to solve these problems by reason of its 50 years' experience in making Bell telephones and other voice transmission apparatus.

All over this country, and indeed the world, a discriminating public flocks to Western Electric equipped theatres—one more proof of this company's leadership in *sound.*

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THE WESTERN ELECTRIC SOUND SYSTEM GIVES YOU TALKING PICTURES AT THEIR BEST IN OVER 6,500 THEATRES

the value of carrot top and lettuce concentrates. These seem to be especially valuable as a source of iodine, manganese, iron, and copper.

The relationship of manganese, copper, and iron to anemia has already been emphasized in many publications. Much has been written of the value of liver in control of anemia. The South Carolina authorities urge oysters as of interest in this connection.—*M. F.*

TRANSPACIFIC SPEED RECORD

A THIRD record was shattered when the Canadian Pacific liner *Empress of Japan,* completing her first voyage from Japan to Canada, docked from Vancouver, Victoria, and Honolulu at Yokohama recently. The elapsed time for the trip from Honolulu to Yokohama was 6 days, 19 hours, 43 minutes, or about 20 hours faster than the previous record held by the N.Y.K. liner *Chichibu Maru.*

During her Pacific lifetime of only a few months, the new Canadian Pacific liner has broken the record for each leg of the voyage.

IRON BASE FOR EXPERIMENTAL HIGHWAY

A CONTRACT for an experimental pavement with an iron base and curb has been placed for 150 feet of pavement, on the Grand Avenue Connection, near Springfield, Illinois, with the Rochester road, (State Highway, Sagamon county.) The roadway to be laid this month will be the first test of three different designs. The iron base and curb will be laid on a levelled highway, says a report which discusses the design of this highway, which may revolutionize the building of roadways.

As explained by the engineers, the road will have a carefully rolled and prepared sub-grade on which the iron base and curb will be laid. Next will follow a mastic sand cushion upon which will be placed a layer of two and one half inch or three inch brick with asphaltic filler poured into the interstices between the bricks. The result, it is declared, will be an indestructible base with a smooth riding surface built into the structure with sufficient flexibility to meet temperature changes without breaks or cracks.

The iron base will consist of three 50-foot sections. One will be blue annealed flat sheets and the other two galvanized and corrugated sheets. The corrugations in one 50 foot section will be parallel to the road and in the other they will be transverse. The flat iron base will be ¼ inch thick, and the corrugated galvanized will be 10 gage.

The three types mentioned above will be tested under actual conditions. If they prove successful under traffic conditions, great progress will have been made in highway construction, is the belief of engineers. Such a roadway will not only be flexible, but should eliminate cracking and permanent deformation. The use of rust-resisting materials will insure durability. The iron base is Armco Ingot Iron and will be rolled and fabricated by The American Rolling Mill Company and the brick will be furnished by the Poston-Springfield Brick Company, of Springfield, Illinois. The National Paving Brick Manufacturers Association is co-operating in the test.

Mr. Mosely, the originator of the idea, recognizes that the success of the new metal highway depends to a large extent on the longevity of the metal used.

The blue annealed sheet-iron section of the base for the new experimental iron base highway. The middle cut shows the section where corrugated iron was used as the base, corrugations running parallel to the road. *At bottom:* Brick surface was laid according to regular practice. The road was finished after the accompanying article was written

CRYSTALLINE RUBBER CLEAR AS GLASS

CRUDE and refined rubber are known to consist principally of hydrocarbons. These hydrocarbons are mixed with smaller quantities of various impurities which can be removed only by a series of long and tedious operations. The highly purified rubber resulting from these operations is a clear, colorless, transparent, elastic solid, as clear and colorless, in fact, as the best plate glass. The problem of ascertaining the composition of this highly purified rubber has heretofore been exceedingly difficult because of the fact that two of the most useful processes ordinarily employed by the chemist—crystallization and distillation—could not be applied to the material.

A process has recently been developed at the United States Bureau of Standards by which this pure rubber can be repeatedly crystallized, thus opening the possibility of successfully fractionating it into its constituent hydrocarbons and eventually of determining the formulas of their molecules. The crystalline rubber obtained by this process, as seen under the microscope,

Actual PUMP INSPECTION *Safeguards* ETHYL quality

Ethyl inspector purchasing actual sample of Ethyl Gasoline *from the pump.* In Ethyl laboratories this sample must meet all Ethyl requirements.

MAYBE you've seen these inspectors, driving cars like this, stopping at Ethyl pumps, buying a gallon here and a gallon there. They are Ethyl representatives—making sure that all gasoline sold under the Ethyl emblem has the full extra quality of Ethyl Gasoline.

Each one of these cans is sealed and marked at the filling station and sent to Ethyl laboratories for testing.

The 76 oil refining companies that mix Ethyl fluid with their gasoline cooperate by authorizing these tests so all Ethyl Gasoline will meet the standard you have learned to expect.

Before any gasoline is mixed with Ethyl fluid at the refineries, a sample is sent to an Ethyl laboratory. A test shows how much Ethyl fluid is needed to bring it up to the standard of Ethyl Gasoline. At least this much Ethyl fluid is then added. After the mixing, a sample of the finished Ethyl Gasoline is sent for testing.

But even this is not enough. To make sure Ethyl Gasoline reaches you with quality unchanged, inspectors take samples from Ethyl pumps throughout the country.

So you are triply protected when you buy at the pump that bears the Ethyl emblem. Its standard of quality is never lowered. Ethyl Gasoline Corporation, Chrysler Building, New York City.

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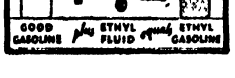
Knocks out that "knock"

Wherever you drive—whatever the oil company's name or brand associated with it—*any* pump bearing the Ethyl emblem represents quality gasoline of high anti-knock rating.



The active ingredient used in Ethyl fluid is lead

© E. G. C. 1930

ETHYL GASOLINE

Ice in the ship channel of a river "rotted" away and a clear channel being made with calcium chloride

consists of small transparent plates. As the crystallization process continues, these plates agglomerate into larger and larger clusters. The crystallization process is carried out by cooling a dilute solution of the highly purified rubber dissolved in ether to a temperature of about -80 degrees Centigrade.—*A. E. B.*

DESTROYING CHANNEL ICE

LAST winter a steamer loaded with valuable cargo was imprisoned in the ice of Lake La Barge near the headwaters of the Yukon River. With buckets and brooms the crew swabbed a strip, 29 miles long and 40 feet wide, of lamp-black and thinned refuse oil across the ice. And because black absorbs the sun's rays and retains heat, this strip in the course of a month cut a channel a foot deep as evenly as though it had been sawed. It continued to deepen and widen so that the boat was released from the ice one month ahead of its usual time.

At Morrisburg, Ontario, a steam ferry operated all last winter on schedule through a channel kept open with the aid of calcium chloride.

Here are typical examples of the results obtained by Dr. Howard T. Barnes, of McGill University, who is acknowledged as the world's leading exponent of the new science of ice engineering. He has discovered that calcium carbide, calcium chloride, sodium chloride, charcoal, lampblack, and cinders will "speed up" the spring thaw of river, lake, and harbor by as much as one month. These materials "rot" and destroy surface ice in the most frigid temperatures, leaving it weakened to such an extent that when the sun swings northward in the spring, the ice melts quickly along these lines of least resistance and passes down stream in small cakes. By spreading these chemicals in a definite pattern over the ice with the aid of an ordinary road-spreader, young ice has been destroyed in a few minutes and channels kept open in proportion to the economic desirability of such work.

Dr. Barnes has also developed two very powerful weapons against icebergs and ice jams. One of these is thermit, which was first described in the press several years ago. Placed in shallow holes dug in the ice at strategic points, it is touched off either with a fuse or a small charge of flashlight powder. The iron oxide and aluminum powder, of which it is composed, instantly react by producing a temperature of 5000 degrees while streams of molten steel are shot through the ice in all directions. The surrounding ice is literally decomposed into its constituent elements of hydrogen and oxygen, the former being released as a flaming gas which often flares a hundred or more feet into the air.

By this means Dr. Barnes destroyed an immense ice jam in the St. Lawrence River which weighed more than 1,000,000 tons, only two 90-pound charges being employed. On another occasion he vanquished an iceberg which measured 500 feet at the water line with a single charge of 100 pounds.

Last winter the ice engineer perfected a new weapon called solite. It is equally as powerful as thermit, but needs neither fuse nor battery to touch it off. Loaded into bombs it can be dropped on otherwise inaccessible icebergs from speeding planes with no risk to the operator. The bombs are open at the top, and as they rush through broken ice a partial vacuum is formed in the hole which prevents the water from entering. When the bomb finally comes to rest the water rushes into the hole and automatically ignites the charge. Experiments conducted on the St. Lawrence River last winter and by the International Ice Patrol off the coast of Labrador last spring prove that solite is eminently successful in destroying both ice jams and icebergs.

BUTYL ALCOHOL FROM POTATO PULP

WASTE pulp from potato-flour factories will be used as a raw material for the bacteriological production of butyl alcohol and acetone by a process developed at the Dutch agricultural experiment station at Gronigen, according to a report from the commercial attaché at The Hague. The process is said to overcome the difficulties caused by the varying composition of the pulp and its usually strongly soured condition. Millions of pounds of pulp are available annually, and production using this patented process will be begun as soon as possible.—*A. E. B.*

THE STING OF THE HONEY BEE

THE sting of the honey bee is seldom considered to be of much importance, except when an entire swarm attacks a man; then he is likely to suffer greatly from manifestations of his disturbance. When a person is stung by a bee it is customary usually to apply solution of ammonia or of baking soda to the skin. Ordinarily this is sufficient to modify the local irritation, and little more is thought of the trouble.

Some studies recently completed in the Mayo Foundation indicate that the venom of the honey bee resembles that of the rattlesnake in several particulars. Both poisons when in contact with the blood break down the red blood cells; both poisons when injected into the arm promptly stop its action. Bee-sting poison is a stimulant of smooth muscle, such as is found in the heart and in the uterus and is a dangerous poison to the lining of the blood vessels. Obviously it is a potent substance and if taken into the body in sufficient quantity can produce death as can the venom of the rattlesnake.—*M. F.*

CAR SICKNESS

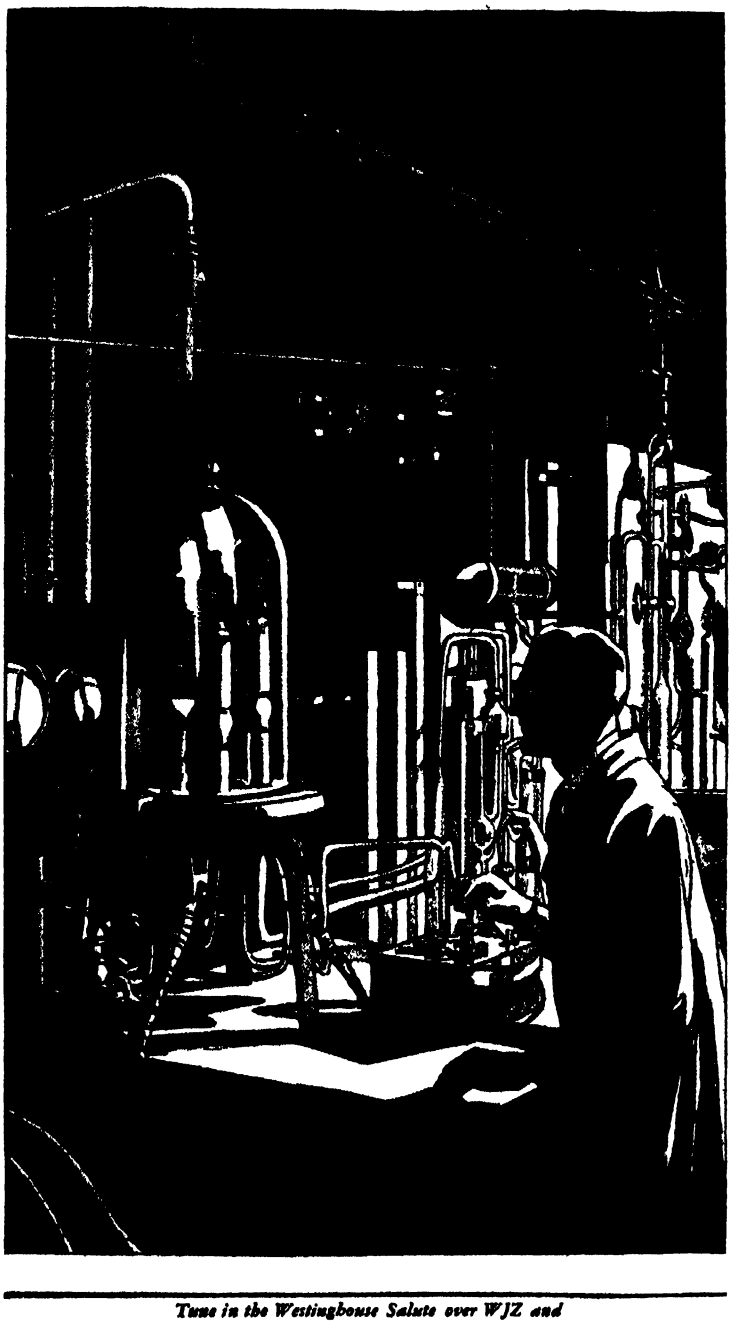
MANY people experience great discomfort when riding in trains or street cars. Many more become dizzy and uncomfortable in ships or airplanes. Physicians who have studied the subject are inclined to place the responsibility on the mechanism of the internal ear and on the eye. The tendency to car sickness seems to run in families. Dr. James E. Lebensohn points out that people most frequently disturbed usually avoid riding backward and favor the front seat of the automobile, where there is less jarring and where the view is less constricted. He points out also that when the land traveler gazes at the scenery, his eyes slowly follow the objects in the landscape which appear to be moving backward. As these objects pass out of the range of the vision, the eyes return to their normal position. Hence the eyes are constantly jerking, and this causes many to believe that the eyes are responsible for railroad sickness.

The chief symptoms of nausea are paleness, sweating, and goose flesh, most of these things being associated with nausea no matter how it is produced. In making a special study of the relationship of the eyes to car sickness, Doctor Lebensohn produced the jerking of the eyes that has been mentioned, known as optical nystagmus, and at the same time studied the changes that took place in the stomach. A cylinder marked in black and white was revolved before the patient's eyes to produce ocular nystagmus and cold water was thrown into the ear to produce labyrinth or internal ear nystagmus. At the same time the contractions of the empty stomach were measured by the movements of an instrument connected with a balloon swallowed and retained in the stomach.

Destroying an ice jam with 12 pounds of solite, the new chemical which is "touched off" by water

ECONOMICS OF THE ELECTRICAL INDUSTRY

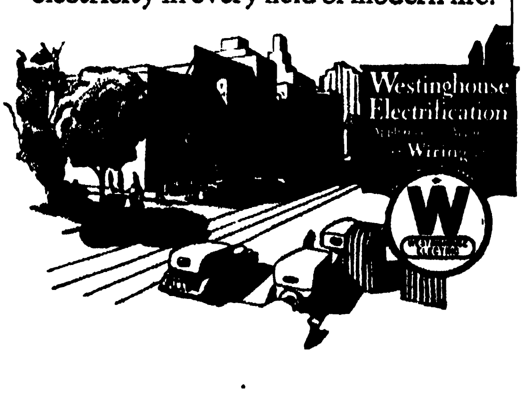
TOMORROW'S COST PROBLEMS...



...in Today's LABORATORIES

Modern science may well smile at the medieval alchemist, calling vainly upon the powers of darkness to aid him in transmuting base metal to gold. The workers in today's research laboratories call upon the powers of electricity — and secrets of far greater value are their almost daily reward.

It is impossible to estimate the vast increase to the world's wealth that electrical research has brought. In the Westinghouse laboratories at East Pittsburgh alone, discoveries valued well into the billions have been made. A cost-saving contribution to a single industry may be worth millions. A new metal to cut down transformer losses, a De-ion circuit breaker that eliminates oil quenching and consequent fire hazard, a marvelous "electric eye" that performs all manner of human tasks — and never forgets; these modern Westinghouse developments are part of the day's work typical of an organization devoted to enlarging the service of electricity in every field of modern life.



Tune in the Westinghouse Salute over WJZ and the coast-to-coast network, every Tuesday evening.

Westinghouse

Welded reaction chamber for a new synthetic process, being tested at the high pressure of 10,000 pounds per square inch without a sign of failure. The working pressure which this cylinder must withstand when in operation is 500 pounds

It was found that the effects on the eye produced little if any response in the stomach concerned with the maximum contractions associated with the production of labyrinth nystagmus. Hence Lebensohn is convinced that car sickness is due to the irritation of the mechanism in the internal ear, but he feels also that errors of refraction in the eyes and of muscle balance predispose a person to this malady. Such errors act as a depressant to the activity of the stomach and people with disturbances of vision are likely to have a lower resistance to nausea than those free from such disturbances.

The development of smoother roads and easier riding in automobiles is making car sickness less common. Dr. Lebensohn states that it is best not to go hungry when traveling, as an empty stomach is particularly sensitive to depressing influences. He recommends also that errors of refraction and of muscle imbalance should be corrected. *M. F.*

HIGH PRESSURE TECHNOLOGY REQUIRES POWERFUL APPARATUS

PROBABLY the most lively topics of discussion among present-day chemical engineers are the several new processes in synthetic chemistry which utilize high pressures and high temperatures. By employing pressures and temperatures heretofore deemed impractical, the chemist has developed commercial processes for the fixation of atmospheric nitrogen, the hydrogenation of oil, and the synthesis of methyl alcohol. From the theoretical standpoint, there is nothing particularly new about these developments but it is only within the last few years that equipment suitable for the severe service required by the new technology has become available. New alloy steels of extremely high tensile strength and corrosion-resisting properties have been developed to meet the demands of high pressure technology. It has also been discovered that welded joints in steel pipes and tanks can be made sufficiently strong to withstand the severe conditions imposed.

What is said to be the most severe test to which a welded container has ever been subjected was performed recently on a welded tank by the A. O. Smith Corporation of Milwaukee, Wisconsin. One of our photographs shows the tank, which is 33 feet long, with 3½-inch walls, and an inside diameter of 26 inches, being subjected to a pressure of 10,000 pounds per square inch without any sign of failure.—*A. E. B.*

QUICK-FREEZING CANNED FRESH PEACHES

WHAT promises to be the first step in the establishment of an important new food industry has just been completed by Tom Huston of Columbus, Georgia, already widely known as "The Peanut King" and as an outstanding example of the South's younger generation of business leaders. While other organizations and individuals throughout the country have been experimenting, without notable success, in the application of the quick-freezing process to fresh fruits, Mr. Huston has organized Tom Huston Frozen Foods, Inc., built a 100,000-dollar plant at Montezuma, Georgia, the first of its kind in the world, and has completed a successful season of freezing fresh, tree-ripened Georgia peaches in commercial quantities.

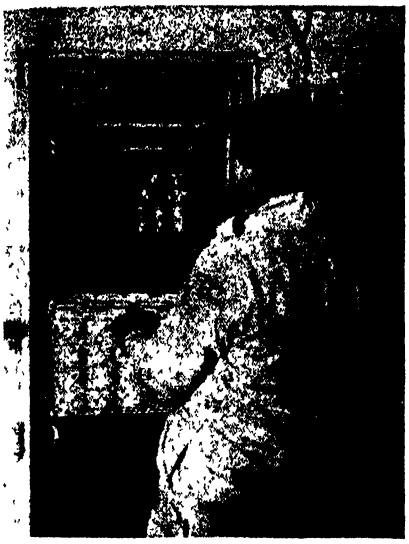
Although for some years it has been a fairly common practice in the Pacific Northwest to freeze strawberries and a few other berries grown in that area, these products have been prepared for use chiefly by ice cream manufacturers, confectioners, and bakers. The Georgia plant represents the first step toward placing frozen fresh fruits on the market for family consumption, and for the entire year round. As such it is of outstanding importance to both consumer and grower, promising the former a new line of healthful and appetizing food products, and the latter a broader, more profitable, and better stabilized market.

Essentially, the process is the same as that which has recently been applied to the quick-freezing of fresh meats. By this method it is possible to imprison the original flavor in the fruit without that breaking down of the cells which accompanies ordinary freezing—a more difficult problem in the case of fruits than meats, since the cells are more delicate. The peaches are allowed to ripen on the trees. They are frozen within a few hours of reaching the plant, which is in the heart of the Georgia peach belt. Thus they have an opportunity to reach their full perfection of flavor, and no opportunity to lose any of it during transportation or while in storage.

Practically all of the fruit is brought from within a radius of about 15 miles of Montezuma. The fuzz and skin are first removed by a special process, after which a belt conveyor carries the peaches to tables where they are split in half, pitted, and carefully inspected. They are then run through slicing machines and down a belt conveyor to other tables where the slices are packed in quarter-pound containers, and a little sugar syrup is added. The containers are capped by machine and then pass through the freezing tunnels where the temperature is 35 degrees below zero. The entire process is completed under the most rigorously sanitary conditions.

The filled containers are kept in a cold

Georgia peaches, to be frozen in the cartons on the conveyor in front of the girl workers, have a sugar syrup added to them from the rubber hose overhead



Arctic clothing in Georgia! In the cold rooms where peaches are preserved by the quick-freezing method, the workmen have to be so clothed against the intense cold

room until ready for shipment. To maintain the necessary degree of cold, they are passed to the refrigerator cars through a portable, insulated tunnel. In the warehouse, hotel, restaurant, club, or drug store they are kept constantly at low temperature.

THE CONSTITUTION AND GASTRO-INTESTINAL DISEASE

In the beginning of modern medicine, that is to say at the time when Hippocrates first introduced accurate observation as the basis of scientific study, attention was paid to the constitution of the human being and his structure in relationship to the disorders from which he might be likely to suffer. Indeed, the Greek teachers classified human types according to various characteristics. Persons of certain types, they asserted, were likely to suffer with certain diseases. The conception was favorably received and guided medicine until approximately the 13th Century, when the beginnings of modern research focused attention not so much on the human being as a whole as on individual tissues and structures and disorders. In more recent years it has come to be realized that medicine must be much more concerned with the human being as a whole. It is recognized that heredity and constitution are of vital importance in understanding the nature of man.

In his chairman's address before the section on diseases of the stomach and intestines at the last annual session of the American Medical Association in Detroit, Dr. Julius Friedenwald gave special attention to the human constitution in its relationship to gastro-intestinal disorders. He called attention to the fact that workers throughout the world are now concerning themselves with this point of view. He mentioned particularly the work of George Draper and his constitutional clinic at the Presbyterian Hospital in New York and the work carried out by Raymond Pearl and his co-workers in the division of human genetics in the constitutional clinic in Johns Hopkins Hospital. Individuals have been measured with relation to the

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Where glass is spun into fine "wool"

various diseases from which they have suffered, the records of their ancestors have been investigated, and it is now realized that the heredity and the constitution of the individual are of utmost importance in the diagnosis and treatment of disease. The mouth may contain extra teeth or be deficient, the palate may fail to close and there may be hare-lip. Tongue-tie may be manifested through several generations. Various forms of indigestion have been associated with certain temperaments. Hypertonus of the stomach is associated with hyperacidity and lower tonus of the stomach is associated with lessened acidity.

Individuals of the heavy athletic type with short chests and long abdomens are likely to have stomachs of increased tonus with the digestive organs high in the abdomen. The individual of frail physique with long chest and a short abdomen is likely to have a poor tone to the stomach and the stomach and intestines will be found low in the abdomen.

Draper found that people with narrow facial angles and forward slanting teeth were likely to have the navel in a lower location than normal, and were likely to be sufferers from ulcer of the stomach. People with gall-bladder irritations were of a steady and more continuous form of behavior, whereas those with ulcer of the stomach were unstable and react quickly to their environment.

Cancer of the gastro-intestinal tract has been shown by Professor Maud Slye to be inherited through many generations of mice, and she has shown the possibility of breeding cancer out of the group as well as breeding it in.

The greatest study of mankind is man, and it is important to realize that it is man as a whole that must be studied as well as the individual features.—*M. F.*

UNIQUE PLANT PRODUCES GLASS WOOL FOR STORAGE BATTERY PLATES

PRIOR to the World War, glass wool was imported almost entirely from Germany for the few specialized uses to which it was put in this country. At that time it was known best in the form of ink erasers and was also utilized somewhat in chemical laboratories as a filtering medium. About ten years ago a demand arose for glass wool on the part of storage battery manufacturers. Accordingly, a plant was built in Millville, N. J., in the heart of a glass producing region, for the manufacture of glass wool. This plant, the only one producing this material in the United States, was described in a recent issue of *Chemical and Metallurgical Engineering.*

Fundamentally, the process of manufacturing glass wool is simply that of heating a glass rod to the softening temperature and then drawing it out into a fine thread. While in slow rotation, the glass rod, which is about three-fourths of an inch in diameter, is constantly heated and softened at its extremity by a small, regulated gas flame. When the glass tip has reached the proper initial softness, an operator touches it with a cold rod and, having accumulated a small "gob" of molten glass, carries it about 15 feet to the top of a large rotating wheel and releases it there. The wheel takes charge from then on; the strand that has been pulled over this distance remains unbroken and is wound on the wheel.

In this unique plant of Friedrich and Dimmock, there are 12 batteries of glass rods and wheels installed. Within 3000 square feet of floor space, some 500 pounds of glass wool are produced daily.

The rod holders operating from one main shaft are mounted on a special iron structure. At one end the 12 horizontal rods are inserted in the centers of individual interlocking gears arranged in a vertical zigzag fashion; these gears transmit the desirable slow rotation. At the other end the rods project through and rest on holes in a vertical panel, which gradually retreats to the stationary end as the rods are used up. On the edge of this panel is fastened a narrow gas pipe, having 12 small jets which melt the protruding glass rods and follow them to their disappearance.

The noteworthy characteristic of this arrangement, shown in the illustration, is its automatic and inevitable synchronism. Once the operator has strung the 12 strands of each battery over their common wheel—a matter of a very few minutes—nothing further need be done until the rods have run out. That is to say, with a given motor speed, the gears will rotate the rods, the gas flame will melt the glass, and the winding wheel will draw the strands, all in a fixed correlation that will give a definite strand size. Thus, if the motor is slowed down, the whole process must adjust itself to produce a heavier strand. What may appear unusual, finally, is that no breakage of the thin glass strands occurs as they traverse the 15 feet of space between units.

The glass wool is finally stripped from the collecting wheels and either shipped in hanks or fabricated into battery insulating plates within the plant. The latter are made from uniform layers of wool that have been dipped in glue and dried in a convection chamber. They are shipped as porous plates with firm smooth sides. Glass wool is also used in filters and light diffusers, and recently as insulation for mechanical refrigerators.—*A. E. B.*

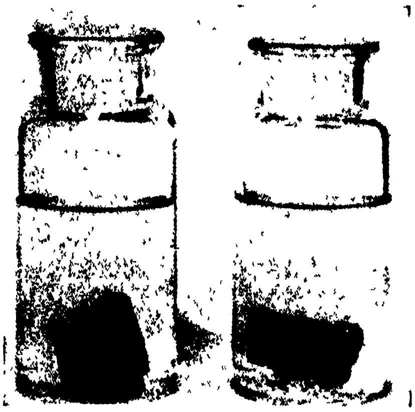
SODIUM SILICATE INHIBITS CORROSION

MANUFACTURERS of shaving soap and cosmetics are increasingly favorable to the use of collapsible tubes as containers for their products. However, one great technical difficulty has militated against the use of this convenient package —namely, the inevitable corrosion of the aluminum tube. Ordinary shaving creams with a soap base, and various alkaline cosmetics, will attack an aluminum tube and in many cases cause its failure within a few weeks, at temperatures well within the range of atmospheric exposures.

Mr. James G. Vail, Vice-President of the Philadelphia Quartz Company, writing in

Test sections cut from shaving cream tubes. The sample at the left shows a dull corroded surface after 30 days. The others show the brilliant surface of aluminum after several months when sodium silicate is used in cream as an inhibitor

a recent issue of *Industrial and Engineering Chemistry* announces the discovery that the addition of less than 0.5 percent of sodium silicate to the soap will stop this corrosive action so completely that the metal remains bright after many months. Sodium silicate used for this purpose is known as an inhibitor and its effectiveness as a corrosion resister is clearly demonstrated in an accompanying photograph. The effect of much larger silicate additions than are needed to stop corrosion has been tested by supplying them for regular use to men who did not know their composition. Some noticed more abundant lather but no unfavorable criticism developed.



Effect of silicate treatment on brick exposed to sulfuric acid. The sample at the left was treated before immersion. That at the right was immersed without treatment. Note the deposit of decomposed brick that has settled to the bottom of the solution in the bottle at right

Another inhibiting effect of sodium silicate which is not yet thoroughly understood, is its power to impart resistance to acid corrosion to such materials as Portland cement or ordinary red brick. The surface of the cement or brick is coated with a dilute solution of sodium silicate which penetrates the pores and results in increased resistance to corrosion, abrasion, and penetration of oil and water.—*A. E. B.*

EAR-PHONE DERMATITIS

As more and more strange chemical substances come into industry, new cases of inflammation of the skin due to special sensitivity are reported. When Mah-Jongg became the popular American craze, innumerable cases of sensitivity to the Japanese lacquer used on the Mah-Jongg boxes or tiles were reported in medical literature. A few years ago specialists in diseases of the skin became aroused over the number of cases of people sensitive to the ink used in rotogravure sections of the newspapers.

Now Dr. J. J. Eller of New York reports the case of a man who had inflammation of the skin over both ears and covering the skin just in front of the ears. The patient had used radio ear-phones for two hours, following which his ears itched and burned and became slightly swollen. After several weeks the swelling gradually increased so that eventually both ears became twice their normal size and then the condition gradually subsided. Similar cases have been reported by other physicians.

(*Please turn to page* 482)

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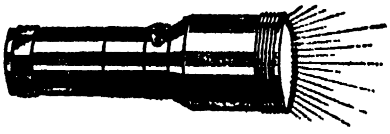

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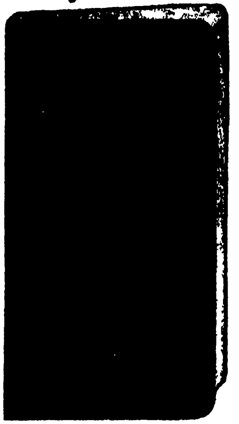

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THE AMATEUR ASTRONOMER

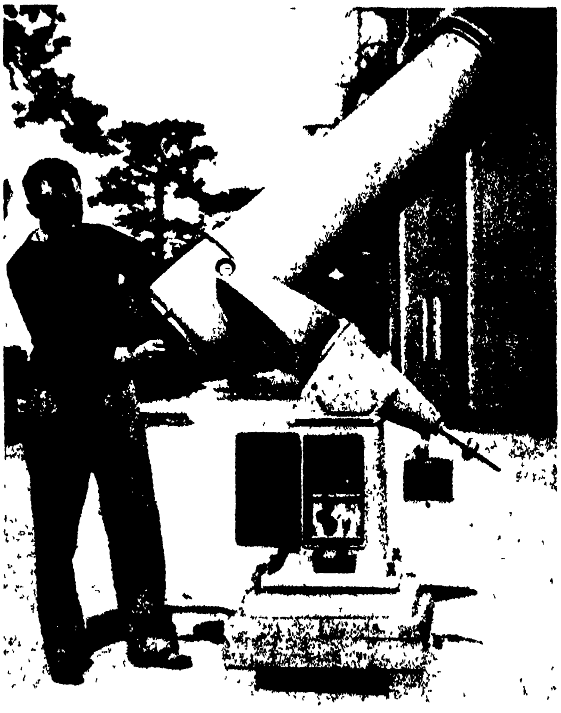
Conducted by ALBERT G. INGALLS

IN the October number, page 320, we reproduced a photograph of one of the four-inch refractors especially designed for the study of various proposed sites for the 200-inch telescope. We now show a photograph of one of two 12-inch Cassegrainian reflectors designed by Russell W. Porter, and approved by Dr. John A. Anderson in charge of the site investigation, for the same purpose. The photograph was sent us by Mr. Joseph O. Hickox of Mount Wilson Observatory. Accompanying it is the following comment:

"Several 12-inch reflecting telescopes have been made for the California Institute of Technology for the purpose of testing seeing conditions at the various sites being investigated for the location of the 200-inch telescope now in course of construction.

"The Pyrex mirrors for the 12-inch reflectors were figured in the optical shop of the Mount Wilson Observatory at Pasadena. The primary focus is five feet, but a Cassegrain focus is available which gives an equivalent focus of 20 feet. Eyepieces of 60, 320, and 480 power are used, the 'seeing' being judged by observing the separate of double stars, the diffraction pattern around stars, and the quality of the detail seen on the moon and planets.

"The mounting is of duralumin, the weight of the complete telescope being 235 pounds. It is provided with reading-circles and slow-motion adjustments for right ascension and declination, and is driven by a clock actuated by a weight."



Cassegrainian for 200-inch site investigation

The photograph reproduced was shown to Russell W. Porter, designer of the telescope, who was induced to dictate the following additional comment: "The specifications laid down for this particular mounting were that it should be very rugged and stand rough treatment, as it was intended to be transferred from one site to another on the backs of pack mules or men, and to be easily separated into convenient units for packing. These considerations made it desirable that all delicate parts be enclosed, as far as possible.

"The entire mounting is of duralumin castings; the tube is of sheet aluminum; the worm gear and adjusting screws of bronze. The only steel in the mounting is the lower bearing of the polar axis and the declination studs. These are chromium plated. The clock weights will drive the clock for 40 minutes before rewinding. The yoke, which is hollow, is especially rugged, and the declination arm and tangent screw are inside one of the arms. A slip ring at the upper end of the polar axis is divided into hour angles, allowing quick setting on any star in right ascension. Hand control in right ascension is by a removable key which engages the worm, whose end can be seen in the little hole on the base casting, just below the yoke.

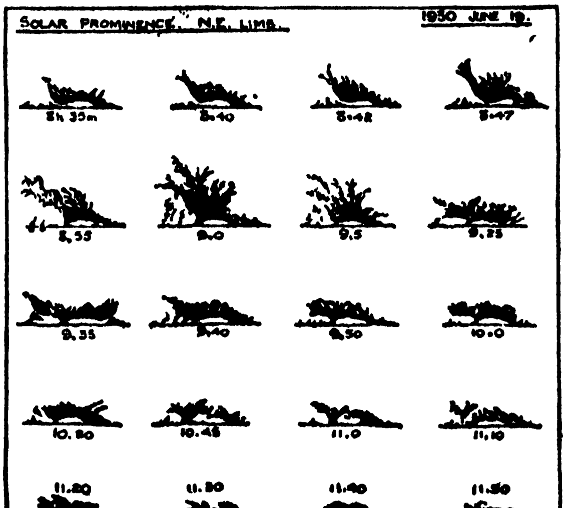
"The cell holding the 12-inch primary mirror is fastened to the casting at the lower end of the tube by a threaded joint making about a half turn. This is not visible on the photograph but lies about halfway between the declination stud and the bottom of the cell. This method of attachment allows the mirror to be removed for safe keeping and to go back again to a positive stop, thus preserving the alignment.

"The whole instrument was painted a light gray with a dull finish and worked down to a beautiful white finish.

"The two telescopes were made by Fred G. Henson of Pasadena. Preliminary tests of the instruments on close doubles showed that the optical surfaces exhausted the resolving power."

THE number of spectrohelioscopes attempted thus far is disappointing. Perhaps the insertion of the series of sketches shown on this page, which gives a concrete idea of what the amateur may expect to see with a spectrohelioscope, may serve to arouse further interest. These sketches were drawn from a solar prominence observed during the morning hours of June 19, 1930 by F. J. Sellers, F. R. A. S., and are reproduced from the *Journal of the British Astronomical Association.* Mr. Sellers points out that this prominence was not a large one, as prominences go, though it was very active. At 9 o'clock A.M. it had reached a height of about 30,000 miles, having risen at the rate of about 12 miles a second.

Seen through the spectrohelioscope these prominences are red and are a moving sight in more senses than one. There are plenty of them; Russell, Dugan and Stewart's "Astronomy" states that it is not at all unusual to find as many as 20 at once on the sun's limb. In 1916 (May 26) one was seen to reach the height of 500,000 miles, ascending at the rate of 20 miles a second. Can you imagine yourself sleeping late on a Sunday morning if you had a spectrohelioscope and could watch such stupendous cosmic events as these? Golf would not pull you away from the eyepiece, nor would motoring. No doubt when the dinner hour came your family would have to feed you forcibly.



Solar prominence seen through spectrohelioscope

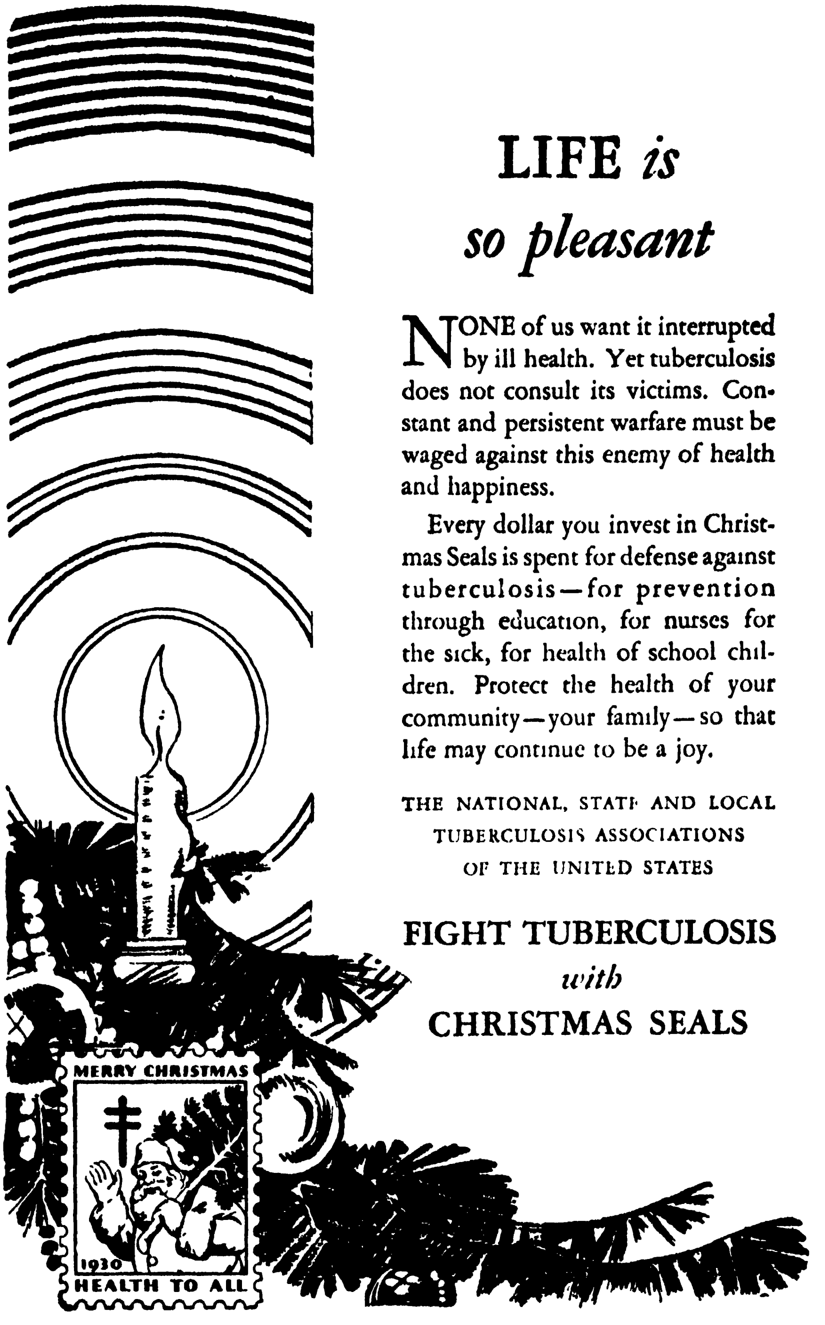
FOR some months we have known that Professor George W. Ritchey had secured the necessary financial backing to begin work on a large telescope of the Ritchey-Chrétien type. He now has made this fact public. He proposes to build a reflecting telescope, of aperture not yet announced, and Miami, Florida, has been selected tentatively as the site. Robert Henkel, Gar Wood, the speed boat builder (who long has been an enthusiastic amateur astronomer), and other Detroit people are his backers. G. H. Lutz ("A. T. M.," pages 243-244) will assist him.

The Ritchey-Chrétien telescope was described by Professor Ritchey in a long series of articles in the *Journal of the Royal Astronomical Society of Canada*, beginning with the May-June, 1928 number. It has a short focal ratio and resembles a Cassegrainian except that, instead of a parabola and hyperbola, a combination of new curves is used. This does away with the distortion of stars not in the center of the field, from which all existing reflecting telescopes now suffer. He also plans to use curved photographic plates accurately ground and polished to a sphere of long radius, since the image projected by the mirror or mirrors of a reflector is not flat but is curved or "dished." He has developed several other extreme refinements, all of which if successfully compounded in one instrument should bring about a striking advance in the technique of telescope making and use. [These mysterious curves have been described—mathematically—in the *Revue d'Optique* (Jan. and Feb. 1922). How to put them on glass never has been described. Don't ask us; we don't know. We asked Professor Ritchey once and his reply was that it is "simple," but he did not describe the method.]

CHICAGO now has an organized group of amateur astronomers and telescope makers, so W. L. Dennis, secretary of the Pickwick Society, 4653 Addison Street, Chicago, has advised us. The Pickwick Society is an established amateur scientific organization but its telescope making activities are new. Its membership includes the professional telescope maker John F Mellish and Professor Philip Fox, Director of the Adler Planetarium, who will act as advisors. The Society already has a seven-inch, two eight-inch, and a ten inch reflector. Its activities will center in the Planetarium where meetings will be held. Mr Dennis asks us to enlist the support of all amateurs in the Chicago district. We wish more power to the Pickwickian elbows. What city is next?

WE learn that the Corning Glass Works (Corning, New York) now has available some standard Pyrex sight glasses which happen to be quite suitable for telescope mirrors. There are several sizes: 6 by ½ inch; 7¼ by ¾; and 9 by ¾. The prices are low. These disks seem pretty thin but should "get by" in nearly every case, as the 8 to 1 ratio usually specified allows a large factor of safety. They often contain bubbles but that can't be helped and these do little or no real harm.

TO complete this month's batch of odd items, here is one furnished by J. V. McAdam, Hastings-on-Hudson, New York. To avoid bubbles in a pitch lap, pour melted pitch on cold tool to half desired thickness and on face of cold mirror (first wet with rouge or soapy water) to equal thickness, and then lay the mirror disk on the other, pitch to pitch. Try it. Mr. McAdam also has modified the Rogers finder (see SCIENTIFIC AMERICAN instruction book "Amateur Telescope Making," page 232) by inserting a monocular in the side of the tube, pointed at a second prism mounted within the tube and in line with the main prism where it intercepts no extra light. An ingenious wrinkle. Although it requires a larger prism, it reduces the number of outside gadgets on the telescope and renders the instrument less vulnerable.



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THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 479)

Ear-phones are made of two compositions: (1) A compound with phenol, similar to Bakelite; (2) A laconite compound which is a mixture of pure shellac, rosin, gum, mica filler, marble dust, and carbon black. Cases of inflammation of the skin have developed from both types of earphones.—*M. F.*

SYNTHETIC PRODUCT FOR FIREPROOFING WOOD

AMONG the many new developments in chemistry disclosed at the recent meeting of the American Chemical Society was the announcement of a new series of compounds known as chlorinated diphenyls. These substances are derivatives of a new synthetic chemical diphenyl, described recently in these columns. Diphenyl is a milk-colored substance made by uniting two molecules of benzene and is used commercially as a substitute for steam for carrying heat in gasoline refining. By adding chlorine in various amounts to diphenyl, a series of derivatives is obtained, ranging in variety from a substance resembling water to light oils, thick syrupy substances, and a light, amber-colored solid.

In a paper describing this substance, C. H. Penning lists various commercial applications for the new compound, such as protective coatings, water-proofing, flameproofing, molding, electric insulation, adhesives, printing inks, artificial leather, leather finishing, textile finishing, sealing waxes, and chewing gum.

"One of the first uses considered when the non-inflammability of the resinous form of chlorinated diphenyl was discovered was as a fireproofing agent for wood," Mr. Penning states. It was found that a practically fireproof product could be obtained, but at a cost considerably greater than when the common mineral salts such as ammonium phosphate, are used. The treated wood, however, instead of being brittle and lifeless, as is the case with the mineral salt processes, gains in strength, and is indeed a superior product.

The thick, oily varieties of chlorinated diphenyl promise to be valuable for their high dielectric constant and resistivity, and their low power factor. These insulating properties make them of great interest to manufacturers of electrical equipment.—*A. E. B.*

CIGARETTE SMOKERS COMPETE WITH GAS

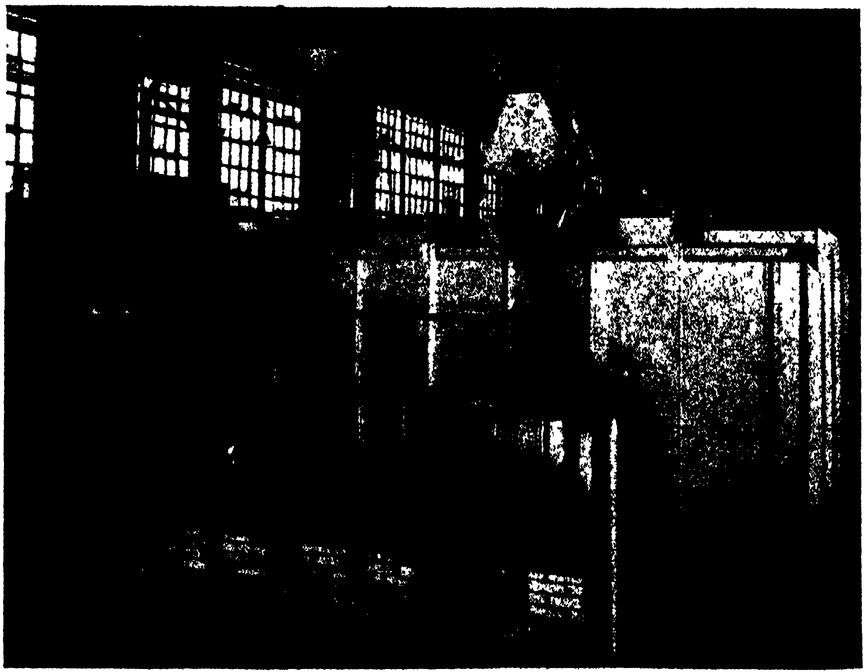
THE people of the United States smoked 127,400,000,000 cigarettes in 1929. If each smoker produced 3½ cubic feet of smoke from each cigarette, the aggregate smoke would just about equal the volume of manufactured gas used in the United States in the year.

BRITISH RIDE ON RUBBER BRICKS

RUBBER bricks have been used in slapstick movie comedies for years, but in some parts of Great Britain the streets are now paved with them. In a report to the Sixth International Road Congress, held in Washington recently, a British delegation told of the success that rubber paving has had in London, Newcastle, Edinburgh, and Glasgow.

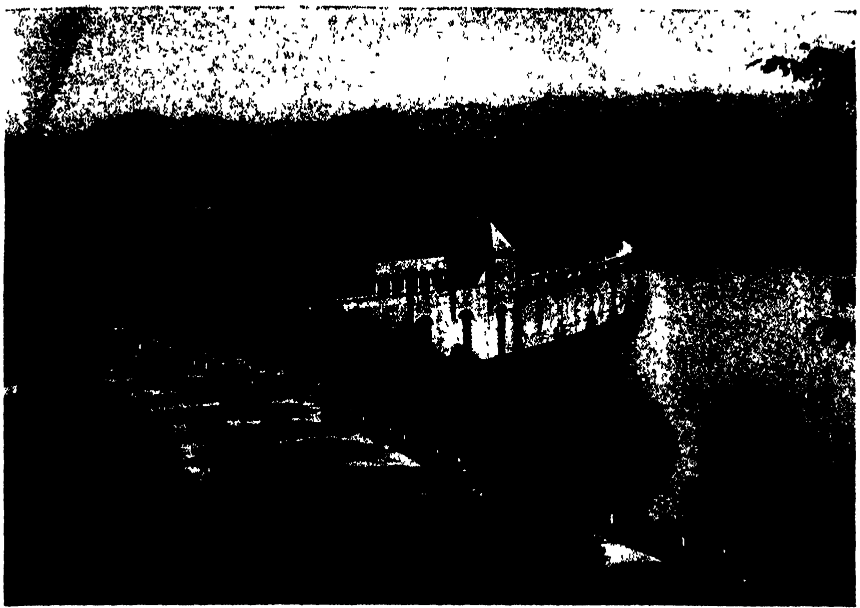
The first experiments to substitute rubber for brick and asphalt were made in 1913, it was stated. A rubber pavement in Glasgow, consisting of blocks of rubber 9 by 4½ by 1½ inches, was laid on a concrete base in 1923.

"Traffic in Glasgow is of the heaviest



Courtesy Westinghouse Electric and Manufacturing Company

Where "the mountain comes to Mahomet." This bell-type furnace is a recently developed time-saver for heat treating metal in great quantities. The metal to be treated is arranged on top of a base, of which a number are supplied, and a crane covers it with the inverted box-like lid which contains the electric furnace. A number of these furnaces may be operated at one time



Courtesy German Tourist Information Office

Europe's largest power dam forming the Eder Valley reservoir, near the famous health resort, Bad Wildungen. The beautiful lake formed by the impounded water is nearly 17 miles long, ⅝ of a mile wide at its widest point, and has an extreme depth of 137 feet. The sites of three villages were covered. The dam is nearly 150 feet high, 900 feet long at the bottom, and 1300 feet at the top. It has the fourfold purpose of maintaining water in the Weser for shipping, feeding the Mitteland Canal, preventing floods, and furnishing water for power

and most trying class," the report stated. "The cap of one block came away from its tread in 1925. This is the only defect reported. The paving is in good condition and shows no apparent wear after six years' use."

An installation in London was in New Bridge Street, which bears some of the city's heaviest traffic, with 17,623 vehicles, or 51,100 tons between 8 A.M. and 8 P.M., in addition to considerable night traffic. This was laid in 1926.

"After two years of wear, 416 blocks, or say 4 percent, were renewed, and now at the end of the third year approximately another 10 percent have to be renewed," the report stated. "The defects are in the nature of blisters and the subsequent peeling off of thin layers of the cap where blisters appeared. The layers stripped off in no case extend the full surface of a block and are about one fifth of an inch thick; the defects cause no inconvenience to traffic, but they collect dirt and are a blemish."

The paving costs about 22 dollars a square yard, laid without foundation, it was stated.—*Science Service.*

FISH-BONE IN THE LIVER

ORDINARILY a fish-bone seldom shows a shadow when the X ray is used to discover its presence in the human body. Occasionally, however, such a bone may be of such size and density as to be easily visible. Such was the case in a woman, 36 years of age, who had all of the symptoms of gall-bladder disease and who went to a hospital for that complaint. When an operation was performed on the gall-bladder, an abscess was found in the side of the liver and a large, thick fish-bone almost an inch long was removed with the matter from the abscess. Apparently when the woman swallowed the fish-bone it stuck in the wall of the small intestine, which then became adherent to the lower surface of the liver. The fish-bone passed through the wall of the intestines and on through the liver because some of the liver became adherent to the wall of the abdomen.

A careful study of the X ray plates made beforehand revealed the presence of the fish-bone as marked on the plate, although it had been overlooked previous to the operation.—*M. F.*

DISCOVER QUEER PROPERTY OF LIVE WIRES

DOES the passage of electricity through a copper wire cause a change in the properties of the metal? G. C. Oland and C. E. White proved to a recent meeting of the American Chemical Society that it does. The discovery was made by submerging a "live" wire and a "dead" one in an acid solution and measuring the amount of metal dissolved from each in a given time. It was found that less copper dissolved from the wire carrying current, either alternating or direct. Strangely enough, however, when lead, nickel, aluminum, or iron wire was used, the metal was attacked more readily while it was carrying a current.

Encouraged by this discovery, the chemists are continuing their experiments to discover the exact physical and chemical changes caused in a metal by the passage of electricity. Perhaps their work may eventually enable chemists to answer the question that has "stumped" physicists and electricians—what is electricity?—*A. E. B.*

BEETLES CHEW HOLES IN LEAD PIPES

THE supposition that metals can be injured by boring and gnawing insects has been confirmed recently by O. Bauer and O. Vollenbruck as a result of systematic experiments in the Kaiser Wilhelm Institut für Metallforschung and in the National

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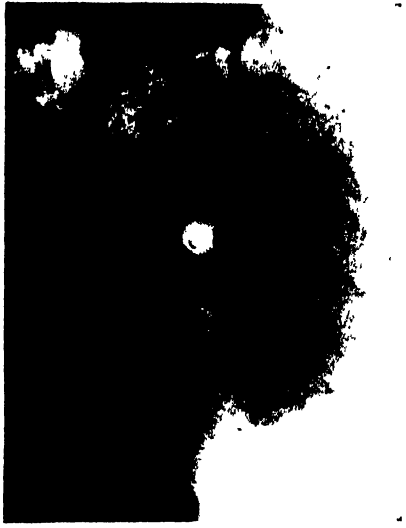
The animals that possess this peculiar metallic appetite are certain varieties of beetles and they are especially fond, it seems, of lead. Cases are on record where the insects have ruined lead, water, and gas pipes, tanks and cisterns, telephone cables, and lead stereotype plates. No attacks of the beetles on aluminum, zinc, or brass could be verified.—*A. E. B.*

DIAGNOSIS OF TRIPLETS BY THE X RAY

OBVIOUSLY it is of importance to diagnose the presence of twins and triplets before their birth. There are many ways in which the physician may do this. He can locate two heart beats, he can feel with his hands the outline of two heads and two spines, and there are various other ways by which he can gain information with his ordinary senses. When, however, there are three children present the situation becomes much more difficult. Hence it is that the X ray was warmly welcomed by the obstetrician as an aid in his work. Dr. Leo A. Rowden in the *British Journal of Radiology* presents the X-ray picture of a case in which, because of the large size of the abdomen, the presence of twins was suspected. Pictures taken from the front and from the side indicated the presence of triplets that lay in the abdomen in various positions. The three children were born on September 19; two of them arrived in the normal order and one reversed.—*M. F.*



Triplets revealed by the X ray

SMOKE-POT WIND INDICATORS

UNITED AIRPORTS of California is marketing with some success a smoke-pot wind indicator. The smoke pot uses cheap fuel oil, holds 25 gallons at a filling, and will produce smoke continuously for 12 to 15 hours without refilling. Any shade of smoke from black to white can be readily produced in accordance with local conditions. The smoke column is heavy and tends to roll along the ground for several hundred feet. Its nominal cost is worth considering. But the mere size of the column as compared with a wind cone or vane is more of an advantage. Also the column bends and veers with every gust and so gives the pilot a precise and instantaneous idea of what the air is doing on the ground.—*A. K.*

FOSSIL WOOD RESEMBLES MODERN PINE

A PIECE of petrified wood from Yellowstone National Park, so perfectly preserved that even the finest microscopic details are practically as clear under the high-power lens as those of modern wood, is described and illustrated in the *American Journal of Botany* by Prof. H. S. Conard of Grinnell College.

It was found in a region where the only previously described petrified woods were those of redwood trees, but its structure is more closely akin to that of one of the species of pine found in the park. Before it could be studied and photographed under the microscope, bits of it had to be ground down thinner than tissue paper, so that light would shine through.—*Science Service.*

OUTBOARD MOTOR AERATES FROZEN LAKES

OUTBOARD motors, advertised by manufacturers as a most valuable aid in transporting fishermen to the scene of their nimrod activities, take a new rôle in the winter—this time assisting the fish. This information was recently received by the Johnson Motor Company, Waukegan, Illinois, from a South Dakota dealer.

In one instance the state game warden called on W. T. Williams, Watertown, South Dakota, owner of an outboard motor, to save the fish suffocating under the ice in a small lake near Goodwin.

Mr. Williams built a stone-boat frame to set his motor in, and hung it at a tilt in a hole through the ice about three feet by six feet. In this position the propeller of the motor threw a heavy flow of water out and over the top of the ice. About 300 feet from the motor, he cut five holes about three feet in diameter, as shown in the accompanying sketch.

The motor was started and ran six days and nights constantly. About every six or eight hours the motor had to be moved back several feet because of the washing away of the ice.

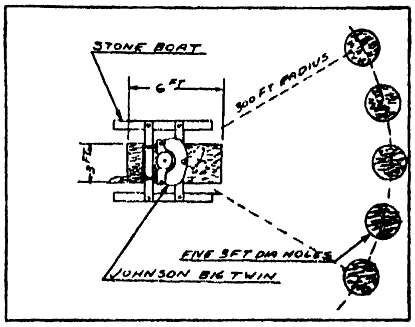


Diagram of how an outboard motor was used to aerate a frozen lake

During the six days a crew of fishermen seined 760 dollars' worth of scavenger fish from the lake, leaving an aerated lake with enough fresh water to save the game fish.

Several times after long continued cold spells, the state game and fish commission have aerated various lakes in this manner.

CURRENT BULLETIN BRIEFS

SHORT REVIEWS OF BULLETINS AND PAPERS ON SCIENTIFIC AND ALLIED SUBJECTS, AND WHERE TO GET THEM

Staple Vitreous China Plumbing Fixtures (Commercial Standards CS 20-30, Bureau of Standards) gives valuable diagrams (with sizes) of various plumbing fixtures. *Superintendent of Documents, Washington, D. C.— 10 cents (coin).*

Copper Electrotyping (Circular of the Bureau of Standards, No. 387) gives an exceedingly valuable resumé of the process and will prove valuable to all who are in any way interested in plating. *Superintendent of Documents, Washington, D. C.— 10 cents (coin).*

Annual Statistical Report of the American Iron and Steel Institute for 1929 gives 129 pages of carefully prepared statistics, the tables being very authoritative. *American Iron and Steel Institute, 75 West Street, New York City. —$5.00.*

The Differential Analysis of Starches (Publication 275—Field Museum of Natural History, Botanical Series Vol. IX, No. 1) by James B. McNair. *Field Museum of Natural History, Chicago, Ill.—50 cents, plus postage.*

Growing Black Locust Trees (Farmer's Bulletin, No. 1628, U. S. Department of Agriculture) by Wilbur R. Mattoon, tells how to grow trees for which there is a demand, particularly for fence posts, stakes, insulator pins, and tree nails. *Superintendent of Documents, Washington, D. C. —5 cents (coin).*

English Sparrow Control (Leaflet No. 61, U. S. Department of Agriculture) by E. R. Kalmbach gives economical and effective methods for local control of this pest. While the nestlings eat insects, this is only for ten or twelve days, whereupon they become confirmed vegetarians. *Superintendent of Documents, Washington, D. C. —5 cents (coin).*

De Florez Manual Control System (Bulletin No. 7520). With this system the operator can almost "feel" the movement of the distant control. The pamphlet tells how. *The Brown Instrument Co., Philadelphia, Pa.—Gratis.*

Fifty Common Plant Galls of the Chicago Area (Botany Leaflet 16, Field Museum of Natural History) by Carl F. Gronemann, while perhaps of local interest, gives excellent illustrations which are botanically correct. *Field Museum of Natural History, Chicago, Ill.—25 cents.*

Passing through Germany is the title of a delightful little travel book of 225 pages, beautifully illustrated. It is not a guide book in the ordinary sense, but takes care of such subjects as the fine arts, vacation study, German politics, et cetera. This beautiful little book is sent for the cost of the postage which can be remitted by two international reply coupons which will cost ten cents.—*Terramare Office, Wilhelm Strasse 23, Berlin, S W. 48, Germany.*

Fundamentals of Pattern Drafting for Sheet Metal Shops is an excellent little treatise on the subject and is well illustrated. *Publicity Department, The American Rolling Mill Co., Middletown, Ohio.— Gratis.*

How We May Get Vitamin A; B and G, C; D (Extension Circulars, Extension Service of College of Agriculture, University of Wisconsin) are four little pamphlets giving radio talks by Mrs May Raynolds of the Home Economics Department, University of Wisconsin. *College of Agriculture, University of Wisconsin, Madison, Wis.— 5 cents each.*

Ways and Means to Traffic Safety gives the recommendations of National Conference on street and highway safety as summarized and approved by the Third National Conference, May 27-29, 1930. *National Conference on Street and Highway Safety, 1615 H. St., N. W. Washington, D. C.—Gratis.*

Aeronautic Publications (Aeronautics Bulletin No. 6, Aeronautics Branch, U. S. Department of Commerce) is a valuable pamphlet citing books and periodicals pertaining to aeronautics. It also gives a complete list of the Aeronautics Bulletins, 25 in number, which are sent free (with one exception) to interested parties. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

The Aeronautics Branch, Department of Commerce (Institute for Government Research, Service Monographs of the United States Government No. 61) by Laurence F. Schmeckebier, deals with the history, activities, and organization of this important branch of the government service. It contains much information unobtainable elsewhere. *The Brookings Institution, Washington, D. C.—$1.50.*

Observations on the Possibility of Methyl Chloride Poisoning by Ingestion with Food and Water, by W. P. Yant, H. W. Shoaf, and J. Chornyak. While there is no definite evidence that food poisoning has occurred or that this type of hazard exists with the refrigerants in current use, nevertheless, the possibility is a matter of concern to manufacturers of refrigerating devices and products, to health officials, and to the public. This detailed study will prove of service to all such persons. *The Roessler & Hasslacher Chemical Co., Niagara Falls, N. Y.—Gratis.*

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Every year the Army marks the festive season by giving Christmas dinners to the deserving poor and toys to underprivileged children, in addition to the year-round care of all who seek its aid, temporal or spiritual.

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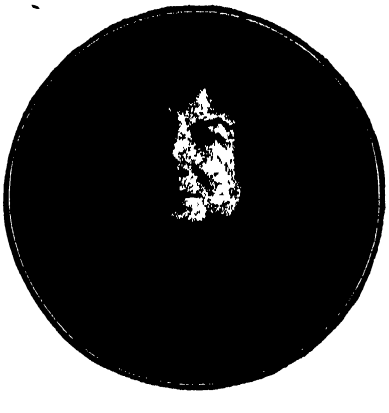

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OUR POINT OF VIEW

(*Continued from page* 429)

from laying off men or reducing wages. Nor is there much substance in the statement that this reduction does not add to the unemployed because men are not discharged until the end of their enlistment. There is a continuous outflow of men from the Navy and unless there is a corresponding intake, the average in the Navy quickly drops. Briefly stated, the Navy Department will draw upon the labor market for just 4800 less men after this reduction, and the ranks of the unemployed are swelled by exactly the same number.

We sympathize with the President's effort to reduce government expenditures in order to avoid raising the income tax; we are aware of the enormous strains put on the Treasury by the operations of the Farm Board, the building of Hoover Dam, the accelerated public-building and road program, and last, *but not least*, the increased cost of prohibition enforcement; we know that powerful interests would oppose any cuts in these expenditures, while there will be few in public place to protest a naval slash. Some of the President's advisers may think it is good politics to save at the expense of the Navy, but we know they are wrong and are confident that the great inert mass of unorganized Americans, patient though they be, will find a way to show their resentment of a continuous surrender of national interest to placate organized groups held together by fanatical, shortsighted, or selfish motives.

Continued Unrest In South America BRAZIL, the largest and most important of the South American states, is in the throes of a revolution that appears at this writing to be succeeding. Already more blood has been spilled in Brazil than in the "palace revolutions" of Argentina and Peru. Probably the fundamental cause of this revolt is the economic depression occasioned primarily by the low price of coffee, Brazil's great export commodity; the alleged cause is that President Luis was elected by gross frauds perpetrated under the protection of the army; unquestionably, the rather easy successes of the revolutionists in Peru and Argentina, followed by their rapid recognition as *de facto* governments by this country, encouraged the present outbreak in Brazil.

This present unstable condition throughout Central and South America, we feel sure, is being carefully considered by the State Department. In general the European powers follow our action in extending recognition to the revolutionary governments, so that our responsibility, though undefined, is immense. Usually our government views with disfavor any violent usurpation of authority, and in a treaty with the states of Central America agreed to withhold recognition from a government based on force. This agreement does not extend to states of South America, and obviously different conditions will require different methods of treatment.

Our investments in Central and South America are colossal. One expert estimates that we have a total investment of 6,000,000,000 dollars in these countries and an annual export trade to them of 1,000,000,000 dollars. Brazil alone takes 100,000,000 dollars of our exports annually; Argentina, 180,000,000 dollars; Cuba, 125,000,000 dollars; and Mexico, 115,000,000 dollars. Thus we have a large economic interest in our southern neighbors.

In addition to the revolution in Brazil, President Machado of Cuba has been authorized by the Cuban congress to suspend the constitutional guarantees in that country on account of threatened outbreaks in Havana. There are also fresh indications of unrest in Mexico. Former President Portes Gil, resigned as head of the National Revolutionary Party, and General Plutarco Calles, reputed strong man of Mexico, issued a warning that the Government must purge itself of disloyal factions. Presumably in response to this threat, Louis Leon, Secretary of Labor and Commerce, resigned and other cabinet retirements are rumored.

The Monroe Doctrine effectively prevents European intervention in South American affairs. It therefore carries a moral obligation on our part to exercise the stabilizing influence which would otherwise be exerted by the Great Powers of Europe. The extent and nature of our intervention in the affairs of our proud Spanish-American cousins can only be determined after careful consideration of the many factors involved; each situation that arises has to be considered on its own merits since no precise rules can be formulated that will cover the various crises that continually arise.

Americans will understand the delicate dilemmas that almost continually confront the Department of State if they will visualize the Latin-American situation as it actually exists and realize that republican institutions and representative governments are ill-adapted to the genius, habits, and mental outlook of the Central and South Americans of Spanish descent, who constitute the real ruling class in these countries and who are entirely unconvinced that the ballots of ignorant *mestizos* should decide the destinies of their countries. The great bulk of the peon population is content to leave the government in the hands of the small ruling class, and the so-called revolutions, for the most part, are merely struggles between certain cliques or oligarchies for power. The prevailing economic depression causes unrest, and the oligarchies out of power have simply taken advantage of it to seize the government.

Our interest lies in the orderly self-development of these countries. We can not force this development which must be a slow evolution; we can carefully avoid hindering this development by officious meddling with their domestic concerns, and we can by friendly counsel decrease the number of, and lessen the savage severity that sometimes marks, these revolutionary shifts of authority. And at all times we can protect these states from foreign intervention which would further complicate their already difficult problem.

It is a singularly fortunate fact that Mr. Hoover toured Latin-America prior to his inauguration. This visit, intended mainly as a gesture of our friendship for its people, has furnished him valuable first-hand information of conditions in this important and temporarily disturbed region. The President's personal knowledge of the situation will assist him to determine practical measures to be undertaken by the United States. And our President should not be hampered in his efforts by uninformed critics or partisan politicians.

The British Imperial Conference THE Imperial Conference composed of delegations from the self-governing dominions and India, opened in London with Premier MacDonald presiding. Many important questions will be considered by the Conference but the most interesting one was disposed of before the Conference met when a member of the British Government formally conceded the right of any British Dominion to secede from the Empire. It had been expected that Premier Hertzog of the Union of South Africa would assert the claim of his dominion to withdraw from the Empire voluntarily, and there were some that professed to believe the British government would contest the claim.

The attitude of the British Government in this matter is just one more instance that the British Empire differs fundamentally from all previous empires, for it is impossible to imagine any other ancient or modern empire permitting a province to pass from its control without a struggle.

The decision of the British Government is probably based on two primary considerations: (1) The inability of the loose-jointed Empire to coerce an unwilling dominion; (2) The unprofitableness of retaining a reluctant member in the Empire. Our successful revolution in 1776 changed the whole attitude of the British people towards their colonies, and the enormous military effort necessary to subdue the Boers in 1899 convinced the British people that it would be poor policy indeed to attempt to keep a dominion in the Empire against its will. The announcement of the government is but an official acknowledgement of an already tacitly accepted principle; none-the-less its formal admission marks an epoch in imperial politics.

In addition to the sentimental ties that bind the dominions to the United Kingdom, there is the very practical consideration that the British Navy and Army are always ready to defend the dominions from external aggression. An Australian or Canadian pays a small tax for the defense of the Empire compared to the tax paid by a resident of the United Kingdom. And we imagine the right to secede will remain in academic abeyance for a long time to come.

The Conference is seriously studying the possibilities of intra-Empire trade, and while the difficulties confronting the Conference are apparently insuperable, it is altogether probable that some measure of trade preference within the Empire will be evolved. It will have to take some shadowy form that will not frighten the Free-traders in the United Kingdom who violently oppose taxes on food, or the Protectionists in the Colonies, who are seeking to build up their factories. Whatever form it takes, any success obtained is almost bound to be at the expense of some of our trade with the United Kingdom and with the dominions. One reason for the British dislike of Briand's proposed United States of Europe was the economic union of continental Europe that would accompany such a development, and the adverse effect it would have on British trade. The struggle for world trade is increasing and is the secret source of many of the so-called policies of the great powers.

A Ray of Hope in China YOUNG Changsu Lin, ruler of Manchuria, took advantage of the exhaustion of the warring factions in Central China, and marched without opposition into Peking. Ostensibly he came to the support of the Nationalist government, the new capital of which is Nanking, which had entirely absorbed its energy in resisting rebellious war lords.

While outwardly the power still is in the hands of the Nationalists, actually it lies with Chang and his army. Manchuria has been enjoying law and order while the rest of China has been devastated by civil war; so far as Chang is able to extend his dominion, he will restore peace to the distracted Chinese. If the Nationalists can accommodate their somewhat visionary plans for a Chinese republic with Chang's personal ambitions, they may obtain the use of his army. This combination would enable them gradually to extend their authority throughout central China. But until there is a much stronger feeling of nationalism and patriotism in China than there is today, all ideas of establishing a unified Chinese republic are chimerical.

Chang's father was too ambitious personally to unite with other Chinese leaders, and it is more than probable that the son will prefer to play a lone hand. If so, his support of the Nationalist government will be of short duration. If, on the contrary, a basis of agreement can be found, a fairly stable government extending from Mukden to Shanghai, including Peking and Tientsin, could be set up. If autonomous governments are achieved by local chiefs in south and west China there would be a lull in the civil wars. In time, if unvexed by foreign interventions, these various Chinese provinces would be drawn into some loose form of confederation; and when roads and railways permit fairly rapid communication between its widely separated provinces, a real unification of China may be expected to begin.

MORE ABOUT PLUTO

(Continued from page 447)

keep near one another for almost half a revolution.

At such a time the mutual perturbations must be large, but it will be long enough in all conscience before they can be used to find the masses. Uranus and Pluto also come close to commensurability of periods, for the former completes its revolutions in 84.02 years and three times this is only 2.9 years greater than one revolution of Pluto. The planets therefore return to almost the same relative position after 250 years—during which interval Uranus catches up with Pluto twice.

Figure 3, which is very much like the last one, shows the positions of the planets. At the last conjunction in 1853 the distance of the planets was 30 astronomical units —about the greatest possible. At the next, in 1965, the distance will be only half as great. The perturbations then will be much larger than in the past century and should lead to a fairly good determination of Pluto's mass—*Paris, September 17th.*

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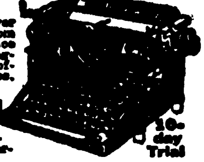

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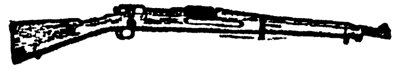

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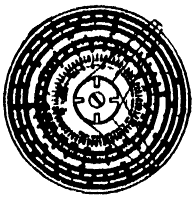

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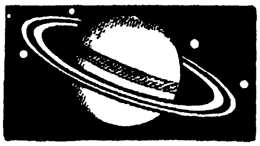

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AVIATION IN 1930

(*Continued from page* 465)

casualties took place in wrecks, but considering all of them the rate is approximately one death per 300,000,000 passenger miles. For the year 1929 there was a death rate among airway passengers of one death in 9000 flights. If an average trip of 300 miles is assumed, this develops into a rate of one death for each 2,700,000 passenger miles. The discrepancy in favor of the railroad is formidable, still not necessarily too formidable.

What is encouraging is that aviation, whether governmental, engineering, scientific, or operational, is fully aware of the importance of increasing safety. The methods of increasing safety are so numerous that they can only be presented in the briefest fashion. But perhaps the following will give a picture of the energy and comprehensiveness of to-day's effort towards safety improvement.

The Guggenheim Safe Aircraft Competition produced a plane, the *Tanager*, equipped with the famous Handley Page slot, which was able to come to rest in 100 feet after touching the ground.

The National Advisory Committee for Aeronautics has undertaken the systematic study of "spinning," that much dreaded cause of accidents, and is evolving valuable data which should enable designers to build planes immune from such troubles.

The Aeronautics Branch of the Department of Commerce has inaugurated a system of licensing airlines, and of licensing only those airlines which are satisfactory in personnel, equipment, and ground organization.

The perfection of radio communication between plane and airport, and the use of such communication by important airlines has arrived simultaneously with the provision of a nation-wide weather service.

Instrument manufacturers are bestirring themselves to produce instruments which will give reliable indication to the pilot in fog flying. At the same time the technique of fog flying is better understood, and systematically imparted in the training of reserve pilots. (See page 430, of this issue.)

The Bureau of Standards has perfected its system of radio beacons, and is now experimenting with a system which will enable the pilot to land safely in fog.

The insurance companies are inspecting planes and airlines and granting better rates to companies of more than usual status from the point of view of safety.

The Packard Diesel engine for aircraft, allowing the use of heavy fuel-oil, removes or diminishes the fire hazard.

The licensing of schools, and the licensing of transport pilots and ground mechanics is improving the status of the operating personnel.

Safety will come as a result of all such efforts, and their value is cumulative.

The aviation industry is at present undergoing a period of severe depression. Many of the smaller airplane manufacturers are closing down, others are retrenching severely on personnel and cutting down on production; two of the biggest holding companies have issued reports showing enormous losses both absolutely and in percentage of invested capital.

Using a hackneyed phrase, the industry is nevertheless sound. The present difficulties are partially due to the general depression now ruling in the United States, partially to the wave of optimistic enthusiasm which swept over the aviation industry soon after Lindbergh's flight. The manufacturers over-estimated the number of planes the public would buy. The schools over-estimated the number of students likely to enroll. The companies erecting airports over-estimated the growth of student instruction and of private flying, and under-estimated the effects of competition in the form of municipal airports. With this enthusiasm there followed a period of over-capitalization, with the public putting up far more money than the industry could profitably employ, so that at the present time the average return on aviation investments is negligibly small.

Yet the industry is growing rapidly all the time. It is only the rate of growth which has been misjudged.

Several favorable factors are already at hand. The Aeronautical Chamber of Commerce reports that the production of new planes is falling slightly behind sales, which indicates that inventories are being slowly liquidated. Severe price reductions which have recently come into effect will hasten this process of liquidation.

Another favorable feature lies in the export of American aircraft. The American industry is exporting an increasing portion of its production. In 1929 nearly 14 percent of its total production value was exported, mainly to Central and South America. At the same time there was a change in the character of the exports. War material and small training planes have been replaced, as far as exports go, by large transport planes of far greater value. As a result of this change, the value of American aircraft exports has more than doubled in the last three years. Nor have exports fallen off substantially during 1930, the worst of all years. For the first six months of 1930 they have totalled 3,256,584 dollars against 3,589,196 dollars in the first six months of 1929.

Again, American air transport is growing rapidly and steadily. The merger of New York, Rio, Buenos Ayres Airlines with Pan-American has resulted in the formation of the largest and most powerful air transport system in the world. In a very few years it will connect every important port in Central and South America with the United States. Pan-American is not only carrying vast quantities of mail, but with the use of large and reliable flying boats or amphibions it is also transporting a larger and larger number of passengers. In the United States progress in air transport is equally rapid. The Aeronautical Chamber of Commerce reports that 133,000 passengers were carried by 29 major transport lines in the first six months of 1929. The poundage of freight and mail was equally impressive, showing 137,398 pounds, with 82,165 pounds carried in the second quarter. The Watres bill which will allow the Postmaster General to place contracts for mail on a space basis and will permit the carrying of mail on passenger airplanes will serve to stimulate the growth of air transport still further.

There is not the slightest doubt that aviation will rapidly work out of the slump and in a few years assume gigantic proportions.

BOOKS SELECTED BY THE EDITORS

ARTIFICIAL SUNLIGHT—*By M. Luckiesh, D.Sc., Dir. Lighting Research Lab., G. E. Co.*

IF Dr. Luckiesh, out of his extensive practical experience with illumination and laboratory testing, set out to write a book suitable for the professional man and intelligent layman alike, he has succeeded in his purpose. Not only the specialist and the general practitioner in medicine, but the average reader would equally well be able to suck the juice from this scientific, technical but not abstruse, though not light-weight, work. Thereafter he would have an advantage over the rest of us who read or hear various claims about the ultra-violet and the infra-red for health benefit but cannot judge of their accuracy because we do not know the "whys" of the subject. But this book is a veritable "why" mine. It covers both solar and artificial radiation and their physiological effects, their measurement, measurement of the ultra-violet, glasses for transmitting it, various artificial sources, and the infra-red.—$3.90 postpaid—*A. G. I.*

STUDIES IN THE LITERATURE OF NATURAL SCIENCE—
By Julian M. Drachman

THE author traces the effect of scientific writing—largely popular and semi-popular, such as that of Darwin, Tyndall, Proctor, Spencer, Eddington—on public opinion and changed public outlook, and therefore on our present age, the Age of Science. Readers who have made an intelligent effort to grasp the real significance of our age in world history will find this book a valuable addition to their library.—$4.20 postpaid—*A. G. I.*

KNOWING that often there is a name or names on the Christmas shopping list for which it is difficult to find something appropriate, we have this month in these pages given you a number of books suitable for Christmas gifts, both for the young and for the adult. We suggest that a well chosen book makes as gratifying a present as can be made.

In the past we have found that many of our readers like to have a cheery Christmas card slipped into the book they give, the donor's name being neatly typed thereon. Our Book Department will be glad to do this for you if you so desire. The whole makes a most acceptable and appropriate remembrance and if you act at once there is ample time to post even to a distance.—*Book Editor*

COMETS—*By C. P. Olivier, Dir. Astronomy, Univ. of Pa.*

THE well-known author of the standard work, "Meteors," foremost American authority on this branch of astronomy, now has written one on the very closely allied subject of comets. It is a popular book of 239 pages and discusses comets from every angle likely to interest all except the incurable mathematician; it is non-mathematical. There has been no such book and this one was needed.—$3.65 postpaid—*A. G. I.*

CLIMATE—*By C. E. P. Brooks, F. R. A. I.*

THIS small work contains descriptions of climates in different parts of the earth. Students of climatology might not find it dull, most others would because of its formal language and the fact that it is for the most part a compilation of statistical data.—$3.20 postpaid—*A. G. I.*

SOIL—*By Archer Butler Hulbert*

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SCIENCE AND THE SCIENTIFIC MIND—*By L. E. Saidla and W. E. Gibbs*

TWENTY-FOUR essays by some of the most noted figures in the world of science, such as Millikan, Soddy, Pupin, Haldane, Slosson, et cetera. An interpretation of those methods of thought which have determined the character of the present age. Five hundred and two pages include valuable appendices of suggested reading and a quite complete list of biographical notes, the whole forming a scholarly and well outlined exposition for mature cultural consideration.—$3.20 postpaid.

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FROM RECENT PUBLICATIONS

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By Inez N. McFee

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HEAR WITH YOUR EYES—*By M. E. Good*

RECENTLY a caller confessed to this reviewer that she had made quite a study of lip reading because she was somewhat deaf and was sensitive about people knowing it. This unique little book outlines by photographs and description a natural method of reading word-forms on the face. The system is simplicity itself and the entire scheme is condensed into 40 pages of text. Sir Richard Paget states that primitive man originated a system of this kind and our modern alphabet developed therefrom. We commend it highly. —$1.15 postpaid.

FOUNDATIONS OF BUDDHISM—*By Natalie Rokotoff*

BECAUSE of the serious unrest in India today this little volume of 137 pages with its crisp, delineating style, will be found to outline clearly the foundations of the forces which keen observers say will eventually make for revolution. One can scarce read with intelligence the news of the day without some background such as is here given.—$1.65 postpaid.

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CHEMICAL PATENT DEDICATED TO PUBLIC INVOLVED IN SUIT

A RECENT decision in a patent infringement suit brought by the Selden Company against the National Aniline and Chemical Company has attracted considerable interest in the chemical industry. Two patents were involved. The first patent covers a process for making phthalic anhydride, phthalic acid, benzoic acid, and naphthaquinones now used in a variety of industries—notably for the manufacture of dyes, medicinal products, plasticizers for nitrocellulose lacquers and artificial resins—and the second patent covers apparatus for carrying out the process, controlling the generating heat, and bringing about reactions of gases.

Both patents were granted without payment of statutory fees by the inventors under the act of March 3, 1883, which provides that any employee of the Government, other than of the Patent Office, may obtain a patent for an invention without payment of the fee required by law, provided that the inventor agrees that the patent when issued can be used by the Government or by anyone in the United States without payment of royalty.

When both inventions were conceived and perfected the patentees were employed as chemists in the United States Department of Agriculture and the evidence at the trial was clear that they considered they had dedicated their rights entirely to the public. However, before the patents had issued, they attempted to make an assignment to the Selden Company, who set up various defenses including some apparently conflicting decisions to justify their belief that they had a proper right under the patents and could prevent their infringement by others.

The court held, however, that the intention of the parties to dedicate their rights to the public was clear and that "the public" meant not only employees of the Government but the general public, and therefore the assignment to the Selden Company conveyed no rights, and everyone had an equal right to use the invention without payment to the inventors or any of their alleged assignees.—*A. E. B.*

UNUSED MARK DENIED REGISTRATION

IN *ex parte* Union Co-operative Insurance Association, First Assistant Commissioner Kinnan held that the Union Co-operative Insurance Association, of Washington, D.C., is not entitled to register, under the Act of 1905, as a trademark for printed books, pamphlets, circulars, and so forth, a mark consisting of the representation of a seal impressed in wax including concentric circles between which are written the words "Union Co-operative Insurance Association 1924" and within the inner circle the words "Union Life Insurance For Union Men, Their Families and Friends."

The ground of the decision is that there is no evidence presented that the matter above described was ever used as a trademark.

In his decision, after noting the statement of the examiner, that a large variety of specimens such as leaflets, post cards, and so forth, and a copy of a periodical entitled *Official Organ of the International Electrical Workers and Operators Published Monthly* had been filed; noting further that the alleged trademark appears on the inside of the cover of the periodical in connection with an advertisement of an insurance association and that this periodical contains general reading matter and many advertisements having nothing to do with insurance associations, the First Assistant Commissioner said:

"The various leaflets, post cards, and folders submitted as specimens are mere advertisements of insurance business, intermittently, irregularly, or sporadically issued and distributed indiscriminately without any thought of remuneration. The alleged mark is not, in consequence, used on these leaflets, post cards, and folders in connection with the sale of anything nor is it used in the journal as a name or device indicating the journal. The examiner has held that this use of the particular design is not a trademark use at all in connection with any of the specimens filed. His conclusion is deemed sound."

WHEAT PRODUCT TRADEMARKS

IN a recent decision, First Assistant Commissioner Kinnan held that the J. T. Fargason Grocer Company, of Memphis, Tennessee, is not entitled to register the term "Omega" as a trademark for macaroni, spaghetti, noodles, corn flakes, and rolled oats in view of the prior registration by the H. C. Cole Milling Company, of Chester, Illinois, of that term as a trademark for wheat flour and that the registration which the Fargason Company had obtained under the Act of 1905 should be cancelled.

The ground of the decision is that the goods of the parties are of the same descriptive properties and that the fact that the use by the Fargason Company was known to the officials of the Cole Company is no ground for refusing cancellation.

OLIVE OIL URGED AS MOTOR LUBRICANT

LUBRICATING oils and greases produced from olive oil in Spain are reported by Spanish experimenters to have shown satisfactory results in preliminary tests with motor vehicles and electric motors, according to a report from Consul Austin C. Brady at Malaga, made public by the Department of Commerce.

An appeal is being made to Spaniards to use the domestic product in place of imported mineral lubricants, imports of which are recorded at 64,022,232 pounds for 1928, a large share of which was supplied by the United States. Statistics of the Petroleum Monopoly place 1929 sales of mineral lubricants at 75,387,778 pounds.

PETITION FOR CANCELLATION DISMISSED

IN the case of the Texas Ichthyol Chemical Company *versus* Ichthyol-Gesellschaft, Cordes, Hermanni and Company, Cancellation No. 1085, First Assistant Commissioner Kinnan held that the petitioner for cancellation, the Texas Ichthyol Chemical Company (Texas Ammonium Ichthyolate Co., Substituted), of Burnet, Texas, was properly permitted to dismiss without prejudice its petition for cancellation.

In his decision the First Assistant Commissioner noted the arguments that had been presented and, after stating the appellant had set forth categorically the usual reasons that the federal courts have deemed persuasive in permitting, or refusing to permit, the plaintiff to dismiss the bill without prejudice, said:

"It may be said that none of the six reasons recited on page 12 of appellant's brief as having been relied upon by courts in denying similar motions is so far present in the case at bar as to justify the refusal of the petitioner's motion and the reversal of the decision of the examiner of interferences upon it. Clearly enough the appellant has sought no affirmative relief and nothing in the nature of a cross bill has been presented. It is not clear the appellant would be injured or prejudiced by the granting of the motion beyond the possible annoyance of renewed litigation.

"It is true such judgment would bar renewed proceedings of this character but the disposition of motions to discontinue has not, in equity proceedings, usually been influenced or determined by this consideration."

With reference to the argument that a question of public policy was involved and that the case was "ripe for decision" he said:

"It is not thought there is any public policy involved in the instant proceedings or, if there is any, it is too remote to be considered. As to the testimony being closed, the case being ready for final hearing, or, 'ripe for decision,' it is believed even if these matters are admitted to be true, they are not sufficient to bar the petitioner the grant of its motion to discontinue."

TOBACCO PIPE PRODUCTION LOWER

SMOKERS in the United States are forsaking the pipe, apparently, judging by production figures for last year, according to a statement Sept. 11 by the Assistant Chief Statistician of the Census of Manufactu[illegible] John F. Daly. The statement follows in full text:

That American smokers are forsaking the pipe, the historical, the original and probably the most leisurely manner of smoking, is indicated by census figures.

According to the preliminary census of manufacturers' statistics the production of tobacco pipes last year showed a decline of 25.1 percent as compared with the production in 1927. The total shipments or deliveries of tobacco pipes in 1929 by manufacturers in the United States were valued at 5,202,185 dollars, as against 6,946,576 dollars reported for 1927, the last preceding census year.

The pipe production in 1927 also represented a slight decline as compared with the 7,298,595 dollar total for 1925, and this in turn was materially lower than the 9,704,816 dollars reported for 1923.

Other figures on the industry for 1929 were also in keeping with those on production. Only 22 establishments were engaged primarily in the production of tobacco pipes last year, which number shows a decline of one as compared with 1927. The 22 manufacturers gave employment to 1667 wage earners, to whom they paid 1,994,057 dollars in wages, which represented decreases of 7.7 percent and 14.7 percent, respectively, as compared with 1807 wage earners and 2,278,537 dollars paid in wages in 1927.

For materials, containers, and electric current, the manufacturers paid 1,716,788 dollars, a decrease of 36.9 percent as compared with 2,722,706 dollars in 1927. The value added by manufacture (value of products, less cost of materials, and so forth) also showed a decline, being 3,751,898 dollars as against 4,551,100 dollars in 1927, a decrease of 17.6 percent.

Of the 5,202,185 dollars' worth of pipes produced last year, briar pipes totaled 4,530,464 dollars and corncob 556,031 dollars, while other pipes produced were valued at 115,690 dollars, and other products at 266,501 dollars.

DESCRIPTIVE MARKS DENIED

IN *ex parte* J. B. Martin Company, First Assistant Commissioner Kinnan held that the company is not entitled to register, under the Act of 1905, the word "Opalescent" as a trademark for silk velvets and velvets of silk and rayon, since this word is merely descriptive of the goods.

In his decision, after referring to the dictionary definition of the word "opalescent," the First Assistant Commissioner said:

"It is well known that the goods to which the applicant applies the notation, when considered as piece goods, are made in different colors and frequently possess the property of reflecting light at different angles with a kind of iridescence which, in some instances, may be fairly well termed 'opalescent.' The word is a common descriptive word in our language and any part of the public should be permitted to use it in connection with goods of this character and no one should be permitted its exclusive appropriation."

In another decision affecting the same company, Dr. Kinnan held that they are not entitled to register, under the Act of 1905, the term "Chinchilla" as a trademark for silk velvets and velvets made of silk and rayon, since the term also is merely descriptive of the goods.

In his decision, after noting that the examiner had relied upon certain decisions in support of his holding that the goods of the applicant are of the same descriptive properties as woolen piece goods or thick heavy cloth from which coats are frequently made, and noting applicant's argument that the name as defined in the dictionary is the name of a South American rodent or its fur and at the most would be merely descriptive of applicant's goods, the First Assistant Commissioner said:

"It is held, since this word has long been used to describe a fabric made somewhat in imitation of the fur of the animal, purchasers would be led to believe the applicant's goods were likewise made in imitation of the fur and would interpret the term as merely descriptive of the fabric. The term having been for so long a time applied to a fabric in a descriptive sense, it is deemed the applicant is properly held to be seeking registration of a mark which is merely descriptive of the character or quality of the goods."

RUBBER TIRES vs. RUBBER BELTING

FIRST Assistant Commissioner Kinnan recently held that the holding in a prior decision that C. Kenyon Company, Inc., of New York, New York, is not entitled to register a trademark for vehicle tires in view of a prior registration by the Goodyear Tire and Rubber Company of substantially the same mark upon belting, should be withdrawn in view of the registrant's statement that it had no objection to such registration and it was not deemed that there would be any confusion by the use of the mark on the different goods.

He further held that, since the refusal of registration had been made in the same decision in which the opposition to the registration had been dismissed, it was believed that, now that the mark was held registrable, the opposition should be reinstated to the extent that a new decision should be rendered which would give the opposer an opportunity to appeal it it so desired.

D. A. R. OPPOSES TRADEMARK

IN the case of National Society of the Daughters of the American Revolution *versus* T. Buettner and Company, Inc., First Assistant Commissioner Kinnan held that the latter is not entitled to register, as a trademark for fabrics upon which are stamped embroidery patterns, a mark consisting of the following notation, arranged as shown:

D
W E A V E
R

The ground of the decision is that the mark so suggests the name of the opposer as to be unregistrable.

In his decision he noted that the opposer organization is frequently referred to as "The D. A. R." and also noted the prohibition of the statute against the registration of names, and so forth, of any organization, and so forth, incorporated in any state and the provision of the Trademark Act that the word "states" includes the District of Columbia and that the opposer was incorporated in the District of Columbia.

He then said:

"In a proceeding where an opposer of this character is involved, public policy as well as the statute and the settled practice justifies waiving all doubts against the applicant. There appears to have been no satisfactory reason for making so prominent these letters "D A R" which it is a matter of common knowledge have come in substantially all parts of this country and among all classes to indicate the opposer society."

He then stated that irrespective of what might have been the applicant's intent: ". . . it is believed there is a probability of purchasers or customers attaching some significance to the use of these three letters and being misled into the belief that the opposer society indorsed or approved of the applicant's goods. Any such interpretation of the applicant's mark would damage the opposer since its name would be to that extent degraded to the level of commercial activities."

RUG ANCHORS

IT was recently held by First Assistant Commissioner Kinnan that The Hoover Company, of North Canton, Ohio, is not entitled to register the notation "Anchorug" as a trademark for a dressing to be applied to the back of a rug to prevent slipping and curling, in view of the prior adoption and use by the E. I. duPont de Nemours & Company, of Wilmington, Delaware, of the notation "Rug Anchor" as a trademark upon materials preventing rugs from slipping.

The ground of the decision is that the goods are of the same descriptive properties and the marks confusingly similar as applied thereto.

In his decision, after stating that the opposer had used the mark upon a sheet or mat, on one surface of which was placed an anti-slipping composition, the mat being adapted to be placed under a rug with the anti-slipping surface in engagement with the floor, while applicant's goods are in the nature of a liquid dressing to be applied to the rugs, and noting that the goods are physically unlike in appearance, the First Assistant Commissioner said

"The goods of the parties would, clearly enough, not be confused by purchasers. They are, however, for the same general purpose of preventing by anti-slipping composition the slipping of the rug. In the one case the material is spread directly upon the rug and dries to a suitable consistency, while in the other case a similar composition as to function and purpose is spread upon the fabric, which in turn is made to engage the rug upon its other surface. It is deemed quite probable that anyone familiar with the opposer's goods, and seeing those of the applicant on the market, would be led to conclude the latter were produced by the opposer. That confusion of origin would result if the respective marks appeared in the same market upon the respective goods seems a fair conclusion."

With respect to the marks, he said:

"As to the marks themselves, that of the applicant is practically a mere reversal of the two words adopted by the opposer. There seems to be no reason why, if the applicant did not wish to obtain some advantage from opposer's commercial activities, the applicant selected a mark so nearly identical with that of the opposer."

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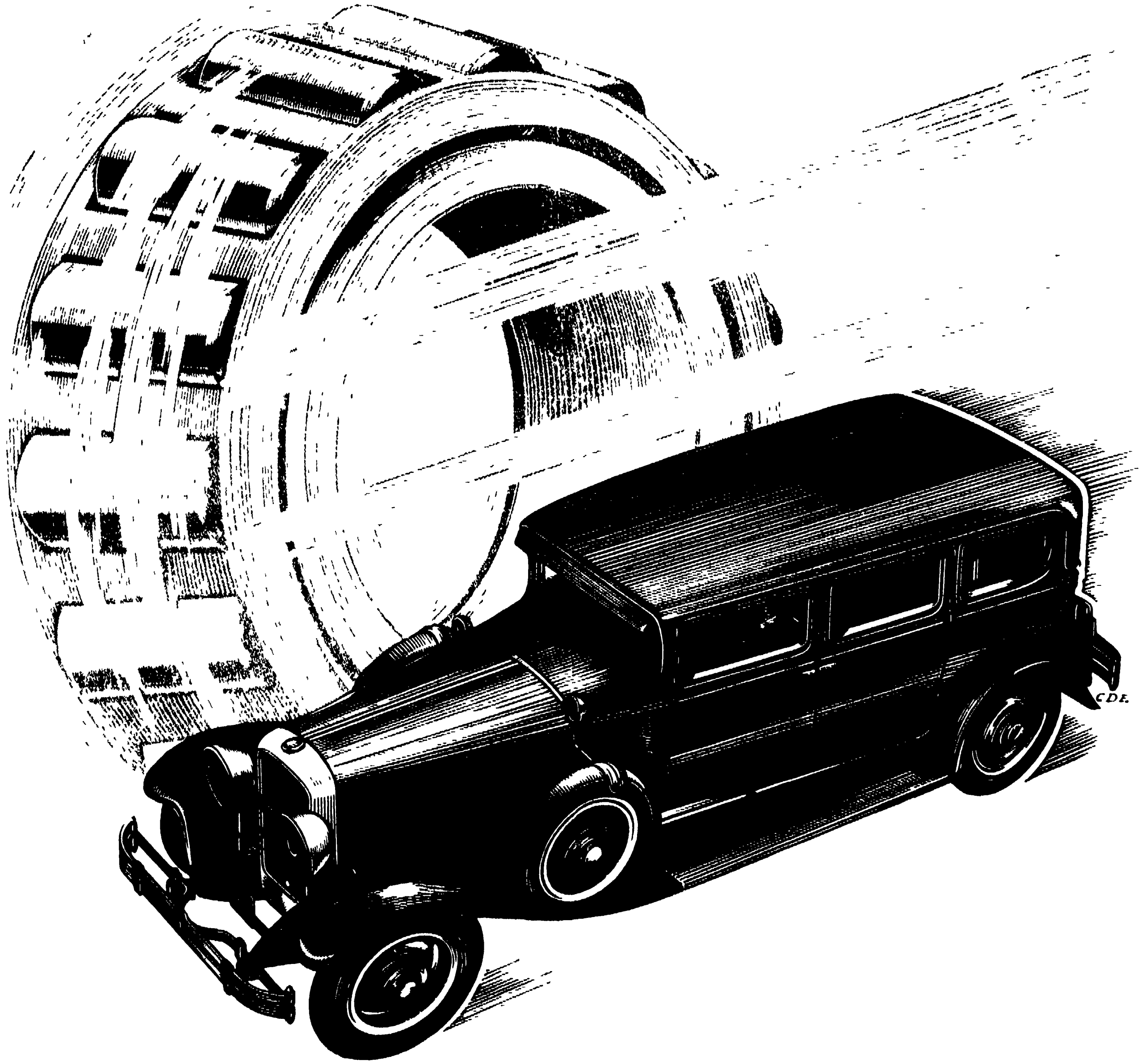

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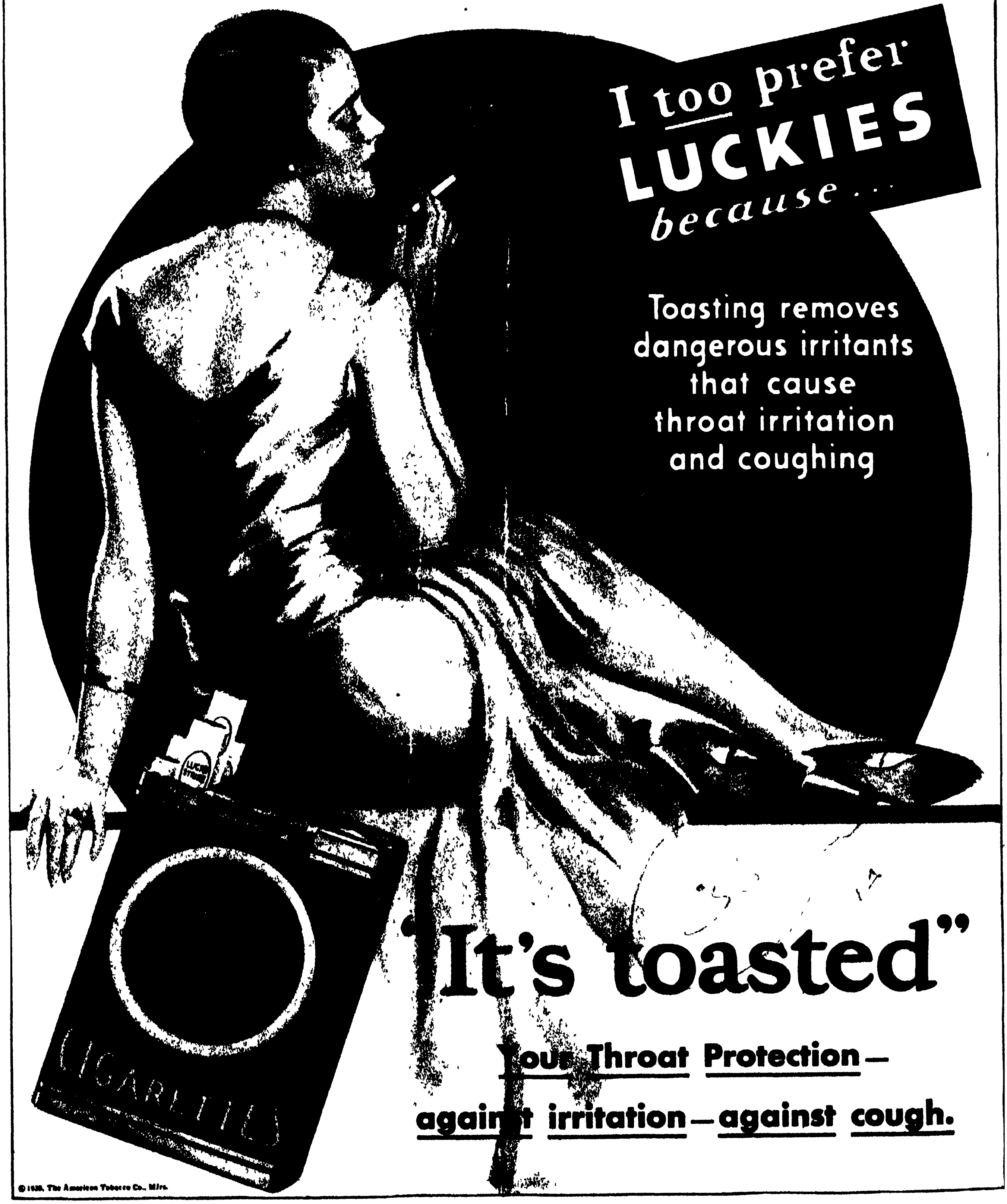

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